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AN ECONOMIC STUDY OF

OIL AND GAS ROYALTY RATES

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TABLE OF CONTENTS

		Page
Table of Contents		
List of Tables		
List of Figures		
Acknowledgments		
Executive Summary		
I.	INTRODUCTION	1
II.	OIL AND GAS LEASING ON STATE LANDS	3
	o Legal framework	3
	o Financial Structure and dollar flows	6
	o Historical overview	9
III.	POLICY ANALYSIS	18
	o Policy objectives	18
	o Policy issues	19
	1. Full market value	19
	2. Permanent trust versus income	20
	o Analytical approach	21
IV.	COMPARISON OF LEASING POLICIES & CLIMATE FOR DEVELOPMENT	23
	o Leasing policy comparisons	23
	Other States	23
	Fee Lease Survey	26
	o Taxation comparisons	30
	o Production costs	33
	o Production and drilling success	35
V.	DETERMINANTS OF LEASING AND DEVELOPMENT: AN ECONOMIC DECISION	40
VI.	ANALYSIS OF CURRENT POLICIES	49

VII. IDENTIFICATION OF ALTERNATIVES 53

VIII. ANALYSIS OF ALTERNATIVES 55

Elasticity 55

Analysis of Alternatives 57

A. Change Royalty Rates 58

B. Change Lease Duration 62

C. Change Lease Acquisition Method 63

D. Separate Policy for Known Production Areas 65

E. Increase Delay Drilling Penalty 66

F. Different Terms for Different Areas 66

G. Variable Royalty Rate 66

Model Results, Recommended Policy 67

IX. RECOMMENDATIONS 68

X. CONCLUDING COMMENTS 69

XI. APPENDIX

A. Montana Codes Annotated on State oil and gas leasing. 70

B. Department of State Lands Lease Data. 79

C. Statewide oil industry data. 85

D. Leasing policy comparisons. 89

E. Taxation comparisons. 102

F. Analytical model: current policies. 107

G. Analytical model: alternative policies. 111

H. References 115

LIST OF TABLES

		Page
Table 1:	Leasing Policy Comparison	25
Table 2:	Pertinent Terms of Oil and Gas Leases on Fee Lands in Montana	27
Table 3:	Effective Tax Rates Levied on the Production of Crude Oil in Nine Oil-producing States	32
Table 4:	U.S. Drilling Costs and Cost Indices	33
Table 5:	Estimated Cost of Drilling and Equipping Wells, 1979, A Comparison of Western States	34
Table 6:	Total Wells Drilled for Oil and Gas in all Time, to January 1, 1981 (Excludes service wells) and Average Daily Production	36
Table 7:	Selected Drilling Figures, Montana	37
Table 8:	Key Financial Descriptors of State Leasing Expressed in Constant 1982 Dollars	48
Table 9:	Estimates of Long-run Elasticity of Energy Demand	56

LIST OF FIGURES, CONTINUED

Figure 17: Gas Production on State Leases: Old and New Wells; Old and New Royalty Rates 52

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Judson Sweet, a consulting petroleum engineer, was a member of the project team.

While each of the individuals mentioned was constructively helpful, the responsibility for the report, including any errors or omissions, rests with the author, James H. Nybo.

EXECUTIVE SUMMARY

PURPOSE

The purpose of this economic study of oil and gas royalty rates on lands owned by the State of Montana is to analyze various aspects of leasing and recommend the appropriate royalty rate and lease terms.

PROCEDURE

The work was carried out by The Meadowlark Group, a Helena economic consulting firm, with the advice and assistance of an internal review committee appointed by the Department of State Lands. The committee consisted of three Department of State Lands employees, an employee of the Secretary of State's Office, and two industry representatives. In addition, several meetings were held with other persons familiar with the industry, both for the purposes of gathering information and to review and discuss elements of the project. The contributions of these advisors included identification of possible alternative policies, data sources, methods of analysis, effects of alternatives, and conclusions. The full responsibility for the report and its conclusions rests with The Meadowlark Group.

KEY FINDINGS

The objectives which must be met in managing state school lands find their basis in the 1889 Enabling Act, where the United States authorized Montana, the Dakotas, and Washington to be admitted to the Union as states, and also granted public lands to the new states. Section 11 of the Act says that the state may only dispose of land or an interest in the land as provided by law, and must secure "the full market value of the estate or interest disposed of." Article X, Section 11, of the State Constitution, again addresses the matter of the disposal of public trust lands owned by the state, stating "No such land or any estate or interest therein shall ever be disposed of except in pursuance of general laws providing for such disposition, or until the full market value of the estate or interest disposed of, to be ascertained in such manner as may be provided by law, has been paid or safely secured to the state."

These citations of the Enabling Act and the State Constitution are important because the production of oil or gas from state lands, and the payment of royalties for that production, are considered to be the sale of an interest in the land. Other forms of income associated with leasing such as rentals, bonuses, and delay drilling penalties are associated with the right to have access to the land, and to explore, but they are paid whether or not production occurs. Royalties, on the other hand, are paid if and only if minerals are taken from the state land.

The revenues from royalties are placed in the permanent trust fund for the support of public schools in perpetuity. Other revenues, including interest on the trust, are largely available for the ongoing operation of the schools at the time they are received.

The recommendations of this study rely in a major way on the understanding that royalties constitute the proceeds from the sale of a part of the permanent trust lands, and as such must meet a higher standard than rentals

and bonuses. Royalties reflect an irretrievable withdrawal of physical assets from the permanent trust.

The State owns oil and gas rights under 6.2 million acres of land plus an unknown area under navigable lakes and streams. It is estimated that the current level of over 5 million acres under lease constitutes 95% of the maximum likely level of leasing.

In a comparison with other states, Montana's royalty rates are lower than the more common 16.67% rate. Montana's ten year lease term is also longer than the five years more frequently seen. Fee (private) leases in Montana are more commonly 12.5%, with recent leases in the Williston Basin area of eastern Montana being typically 16.67%. Non-competitive (simultaneous filing) leases of the federal government are at 12.5%, while KGS (known geological structures) are on a sliding scale running from 12.5% to 25%. Tribal leases usually begin at 16.67% and sometimes go higher.

Montana's taxation of the oil and gas industry, including both severance taxes and the net proceeds tax (a property tax) is the highest of all states studied. It was not the purpose of this study to evaluate state taxation, but it is reasonable to expect the rational developer to consider the combined effects of lease terms and taxation in deciding whether or not to acquire and develop tracts in Montana. Leasing, exploration, and development are all economic decisions, and are determined by many factors. Key determinants are: oil and gas prices; likelihood of a successful well; level of state and local taxation; and royalty rate and other lease terms. Only the last is under the direct control of the Board of Land Commissioners.

RECOMMENDATIONS

1. Change the oil and gas royalty rates to a flat 15%.

2. Double the delay drilling penalties in years seven through ten, from $1.25 per year to $2.50.

3. Retain the oral auction method of lease acquisition.

RATIONALE

The sale of state trust lands must meet the standard of full market value. An examination of the royalty rates received by surrounding states, as well as those of various entities within Montana, leads to the conclusion that 12.5% does not constitute full market value. Montana's high level of taxation, however, must be considered as a factor in the market. Thus, the recommendation is greater than 1/8 and less than 1/6. The sliding scale currently used for crude oil applies to only a few leases and removes incentive from drilling high risk wells. Accounting for the sliding scale, the weighted average royalty rate for oil production on state leases is just under 13%.

Increasing the delay drilling penalties will raise revenue, and encourage either drilling, relinquishing, or transferring leases. It also allows the lessee to have flexibility in a drilling schedule and in assembling a block, where he is willing to pay for it.

The oral auction, while not perfect, allows for a competitive selection process with the state gaining from the competition, and is equally accessible to both large and small operators. The process can be enhanced by the state's taking the initiative to inform the industry when formerly leased tracts become available.

AUTHOR'S COMMENT

The economic environment in which the petroleum industry is operating today is both complex and dynamic. The greatest value of this report should be in the foundation it lays rather than simply its conclusions.

The Board of Land Commissioners should keep in mind that the adoption of a leasing policy is something which will have effects over the long term. The basis of such a decision should be a longer-term perspective rather than simply a decision of the moment.

I. INTRODUCTION

PURPOSE

This is an economic study of oil and gas royalty rates on lands owned by the State of Montana and administered by the Montana Department of State Lands and the Montana Board of Land Commissioners. Its purpose is to analyze various aspects of oil and gas leasing, and recommend the optimum royalty rate to be charged on State leases in order to maximize revenue for the support of education in Montana.

BACKGROUND

The State of Montana owns approximately 6.2 million acres of oil and gas rights. In nearly all of these lands, the Board of Land Commissioners must manage them to obtain a full market value for the right to explore for and to produce state-owned oil and gas. The rentals and royalties from oil and gas leasing and production are dedicated to the support of public education in Montana. The Board, recognizing the dynamics of the economy and the petroleum industry in the 1970's and 80's, and seeing the substantial level of leasing of state lands in recent years, determined that it could best serve its public responsibility by commissioning an independent examination of royalty rates and other policies, terms, and conditions of leasing.

OBJECTIVES

To satisfy the purpose of the study, the Department of State Lands specified three specific topics of the analysis.

1. The effect of a change in royalty rates on the total income from oil and gas leasing which is available to support education in Montana.

2. The total cost of developing and producing oil and gas on Montana state land in comparison with the total cost on private land, federal land and Indian land in Montana and also in comparison with state land in the neighboring states of North Dakota, South Dakota, Wyoming, Colorado, Utah, and Idaho.

3. An estimated projection of total revenue from oil and gas leasing on

state land at the current royalty rate and an estimated projection of total revenue at the recommended royalty, if the recommended royalty is different from the current royalty. The estimated projections shall be to the year 2000.

The project team and the informal project advisory committee have been directed to construct the issue broadly, allowing room to look at variables in addition to royalty rates, such as lease duration, delay drilling penalties, and so forth.

ORGANIZATION OF THE REPORT

The report first describes the legal framework surrounding the leasing of state lands for oil and gas development, presents an overview of the financial structure and dollar flows under the current leasing policy, and summarizes the historical information on state leasing. Based on the legal framework, the central policy objective of state lands management is expressed, and several policy issues within that objective are specified and discussed. The analytical approach to satisfy the study's objectives includes: a comparison of Montana's leasing policies with those of other lessors; a descriptive analysis of the determinants of leasing and development decisions by the private sector; an analysis of expected activities and revenues under current leasing policies; an identification of alternative leasing policy measures; an analysis of the alternatives; and a recommendation to the Board. Supporting data are located in the Appendix.

II. OIL AND GAS LEASING ON STATE LANDS

LEGAL FRAMEWORK

The Enabling Act. In 1889 the U.S. Congress passed into law an act enabling Montana, the Dakotas, and Washington to form state governments and be admitted into the Union as a state. The Enabling Act, as it is known, also granted public lands to the new states.

The pertinent sections of the Enabling Act are sections 10 and 11.

Section 10 grants to the states sections 16 and 36 of every township, or equivalent lands for the support of common schools.

Section 11 states that all lands granted shall be disposed of only at public sale after advertising. It authorizes leasing for the exploration and production of oil and gas, and gives to the legislature the authority to prescribe regulations, term of years, and conditions for leases.

Section 11 of the Act says that the state may only dispose of land or grant easements, rights, or interest in the land as provided by law, and must secure "the full market value of the estate or interest disposed of." (emphasis added).

> "With the exception of lands granted for public buildings, the proceeds from the sale and other permanent disposition of any of the said lands and from every part thereof, shall constitute permanent funds for the support and maintenance of the public schools and the various state institutions for which the lands have been granted. Rentals on leased lands, interest on deferred payments on lands sold, interest on funds arising from these lands, and all other actual income, shall be available for the maintenance and support of such schools and institutions. Any state may, however, in its discretion, add a portion of the annual income to the permanent funds."

In a 1953 case (State ex rel. Dickgraber v. Sheridan), the amount bid over the minimum per acre rental was determined to be part of the rental and thus placed in the common school interest and income fund to be apportioned

and distributed annually to the several school districts in the state.

The State Constitution. The Constitution of Montana, ratified by the people June 6, 1972, speaks to public lands in Article X, "Education and Public Lands," Sections 2,3,4,5,10, and 11.

> Section 2. Public school fund. The public school fund of the state shall consist of: (1) Proceeds from the school lands which have been or may hereafter be granted by the United States,
> (2) Lands granted in lieu thereof,
> (3) Lands given or granted by any person or corporation under any law or grant of the United States,
> (4) All other grants of land or money made from the United States for general educational purposes or without special purpose,
> (5) All interests in estates that escheat to the state,
> (6) All unclaimed shares and dividends of any corporation incorporated in the state,
> (7) All other grants, gifts, devises or bequests made to the state for general educational purposes.
>
> Section 3. Public school fund inviolate. The public school fund shall forever remain inviolate, guaranteed by the state against loss or diversion.
>
> Section 4. Board of land commissioners. The governor, superintendent of public instruction, auditor, secretary of state, and attorney general constitute the board of land commissioners. It has the authority to direct, control, lease, exchange, and sell school lands and lands which have been or may be granted for the support and benefit of the various state educational institutions, under such regulations and restrictions as may be provided by law.
>
> Section 5. Public school fund revenue. (1) Ninety-five percent of all the interest received on the public school fund and ninety-five percent of all rent received from the leasing of school lands and all other income from the public school fund shall be equitably apportioned annuallyto public elementary and secondary school districts as provided by law.
> (2) The remaining five percent of all interest received on the public school fund, and the remaining five percent of all rent received from the leasing of school lands and all other income from the public school fund shall annually be added to the public school fund and become and forever remain an inseparable and inviolable part thereof.
>
> Section 10. State university funds. The funds of the Montana university system and of all other state institutions of learning, from whatever source accruing, shall forever remain inviolate and sacred to the purpose for which they were dedicated. The various funds shall be respectively invested under such regulations as may be provided by law, and shall be guaranteed by the state against loss or diversion. The interest from such invested funds, together with the rent from leased lands or properties, shall be devoted to

the maintenance and perpetuation of the respective institutions.

Section 11. Public land trust, disposition. (1) All lands of the state that have been or may be granted by congress, or acquired by gift or grant or devise from any person or corporation, shall be public lands of the state. They shall be held in trust for the people, to be disposed of as hereafter provided, for the respective purposes for which they have ben or may be granted, donated, or devised.
(2) No such land or any estate or interest therein shall ever be disposed of except in pursuance of general laws providing for such disposition, or until the full market value of the estate or interest disposed of, to be ascertained in such manner as may be provided by law, has been paid or safely secured to the state.
(3) No land which the state holds by grant from the United States which prescribes the manner of disposal and minimum price shall be disposed of except in the manner and for at least the price prescribed without the consent of the United States.
(4) All public land shall be classified by the board of land commissioners in a manner provided by law. Any public land may be exchanged for other land, public or private, which is equal in value and, as closely as possible, equal in area.

The Laws of Montana. The specific administration of State Lands is addressed in Title 77, MCA, "State Lands." Pertinent provisions of Title 77 are contained in Appendix D.

To summarize, Title 77 gives substantial authority to the Board of Land Commissioners in administering state-owned oil and gas resources. Some specific elements of Title 77 are:

1. Primary lease term is for ten years.

2. Annual rentals are set by the Board, but may not be less than $1.50 per acre.

3. Delay drilling penalties for years six through ten shall be assessed for failure to commence drilling a well, at a rate of $1.25 per acre for the sixth year, and at a rate set by the Board for subsequent years.

4. Royalty shall be set by the Board, but shall not be less than twelve and one half percent.

5. Disposition of revenues to pertinent funds is spelled out.

FINANCIAL STRUCTURE AND DOLLAR FLOWS

Revenues. Revenues accrue to state lands through oil and gas leasing in four ways: royalties, rentals, bonuses, and penalties.

The royalty is the state's share of the full market value of oil or gas produced. A royalty is received when the resource is extracted from the state-owned lands, and is, therefore, treated as a payment for the sale of part of the land. Thus, one hundred percent of royalty revenues must be placed in the permanent fund.

Rentals are the annual amount paid for the privilege of having the lease. Rentals are paid on a per acre basis, and are paid whether or not there is production on the lease. Since the rental itself does not sever a resource of value from the land, it is not considered as a sale of the land. Rental revenues go to the public school interest and income fund, except for five percent, which goes to the permanent trust fund.

Bonus is the term commonly used for an amount over and above the first year's rental which is bid by a successful lessee to acquire a lease. It is treated as a rental for purposes of allocation, with ninety-five percent going to the interest and income fund, and five percent to the permanent trust fund. The law uses the term bonus in another way—in reference to a payment to a producer of an amount greater than the posted field price, when selling his gas or oil. If such a bonus is paid, the state is entitled to its royalty share of the bonus.

The fourth category of revenues is fees and penalties. Fees are assessed by the Department to apply for a lease, to file a lease assignment, and for unitization and communitization. The major penalty assessed is the delay drilling penalty—a per acre amount assessed for years six through ten of a ten year lease, if drilling has not commenced. All fees are credited to the general fund. Delay drilling penalties are treated as rental payments, and go

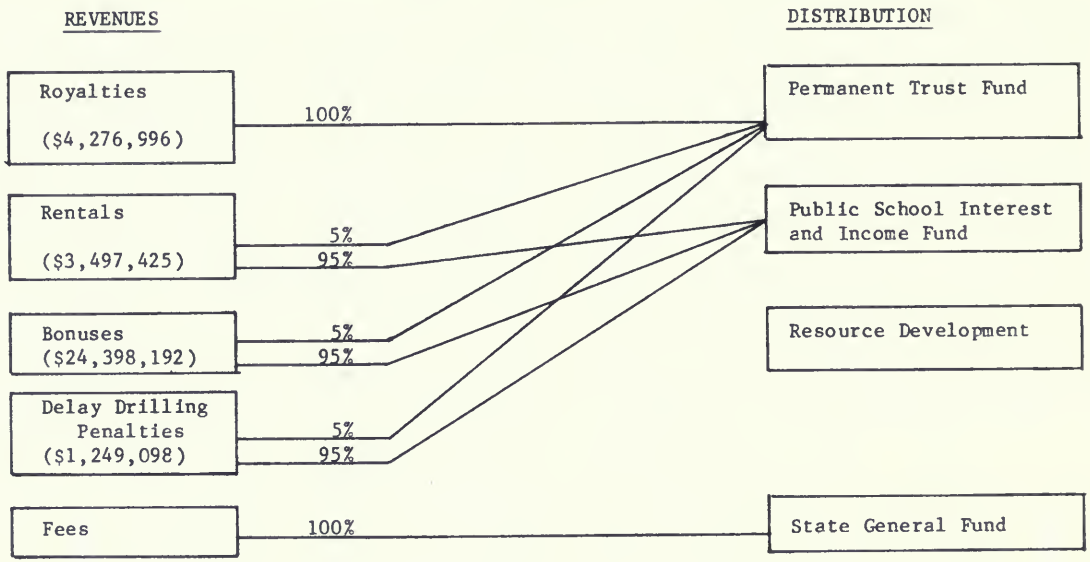
Distribution. Revenues are allocated to three funds and one activity: the permanent trust fund, the public school interest and income fund, the state general fund, and the resource development activity.

For ease of exposition, this analysis refers to the permanent trust fund in the singular, although there are actually thirteen funds cited in the most recent Statistical Report of the Department. The funds include the public school fund with a June 1980 balance exceeding $100 million, and funds for various academic and other institutions having balances from $2 million on down. Revenues are assigned to the fund to which the producing land belongs. Because of the dominance of public school lands and the permanent public school trust fund, this report speaks collectively of the various funds in the singular, with the knowledge that the other funds exist. The principal of the permanent trust fund is inviolate, and the interest is used to support the maintenance and operation of public schools in the state.

Ninety-five percent of the interest on invested permanent funds and income from lease rentals is credited to the various interest and income funds. The remaining five percent goes to the respective permanent fund. As with the permanent funds, the picture is dominated by the public school fund. This report commonly refers to the public school income fund, or simply the income fund, and means collectively the various interest and income funds.

The general fund of the state of Montana is the major fund for the general operations of state government. Its use is set by action of the legislature and the signature of the Governor.

FIGURE 1: OIL AND GAS LEASE REVENUES AND DISTRIBUTION AND FY 1980 DOLLAR AMOUNTS



HISTORICAL OVERVIEW

The Board of Land Commissioners are responsible for approximately 6.2 million identified acres where the State owns the oil and gas rights. In addition, an unknown amount of land which lies under navigable waters could add a quarter of a million or more acres to the total. Figure 2 portrays the phenomenal increase in leased state acres over the past twenty years. Acreage under lease has increased ten-fold in that period. This is a compounded annual growth rate of over eleven percent per year over that period. This growth has been most pronounced in the past few years. Figure 3 presents the number of acres which were newly leased in each individual year during the last twenty years. Here again, the recent strong interest in state leases is seen. The level of new leases appears to be somewhat cyclical, with peaks in 1964, 1968, 1973, 1978, and 1981. Within this cyclical pattern, the general trend has been to increase.

Income other than royalties is found in Figure 4. Income is most heavily influenced by the bonuses from new leases, as well as the increase in rental rates from $1.ØØ to $1.5Ø per acre effective July 1, 1975, and the increased number of leases paying delay drilling penalties in recent years. The average bonus is found in Figure 5, while Figure 6 shows acres paying delay drilling penalties

Royalty income is portrayed in Figure 7. The substantial increases in royalty income are primarily attributable to the major climb in oil and gas prices during this same period. Figures 8 and 9 present production of oil and gas on state leases during the last twenty years. Production has been characterized by variation, with a slight upward trend.

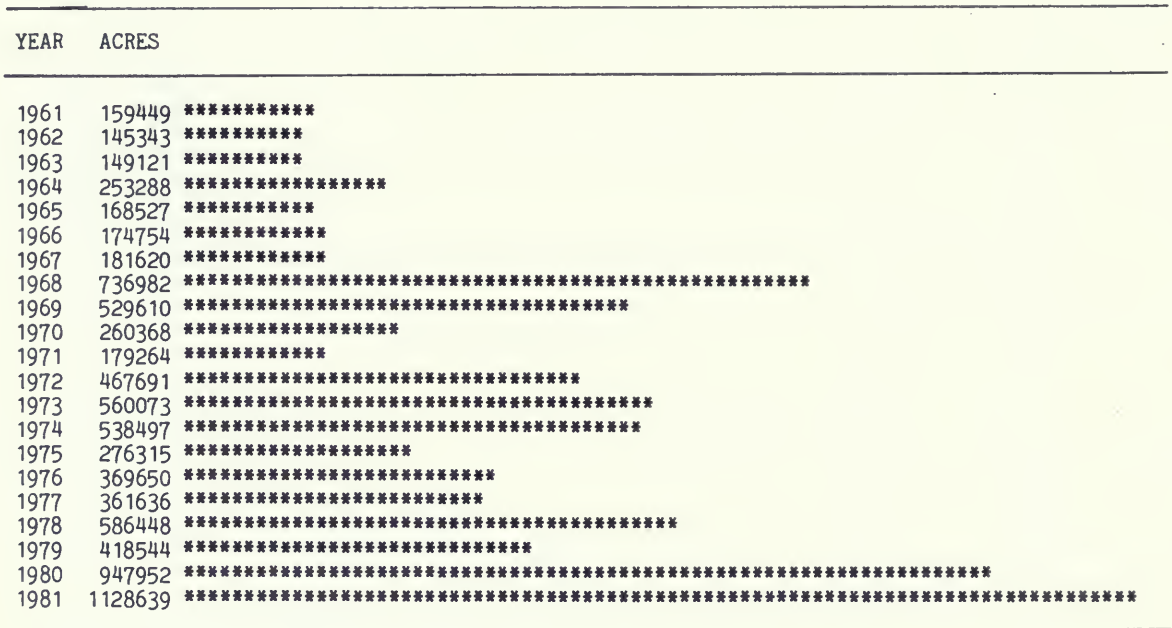
At the present there are 11,272 active leases and over five million acres are under lease. Appendix B, is a detailed summary of data on state leases covering the past twenty years.

FIGURE 2: TOTAL ACRES UNDER OIL OR GAS LEASE, MONTANA STATE LANDS, 1960 - 1981.

YEAR	ACRES	
1960	475638	********
1962	491945	********
1964	614557	**********
1966	617927	**********
1968	736982	**********
1970	1461854	**********
1972	1403653	**********
1974	1897965	**********
1976	2131625	**********
1978	2630787	**********
1980	3636882	**********
1981	4628813	**********

SOURCE: Montana Department of State Lands.

FIGURE 3: ACRES OF STATE LAND NEWLY UNDER OIL OR GAS LEASE THIS YEAR



SOURCE: Montana Department of State Lands.

FIGURE 4: INCOME (EXCEPT ROYALTIES) ON STATE OF MONTANA OIL AND GAS LEASES, 1960 - 1981

YEAR	INCOME	
1960	859474	**
1961	880790	**
1962	872827	**
1963	1075726	**
1964	971653	**
1965	1096004	***
1966	1019543	**
1967	942874	**
1968	5610070	**********
1969	2559307	*******
1970	2075307	*****
1971	1410550	***
1972	1802436	****
1973	2573255	*******
1974	3188482	********
1975	3335467	*********
1976	3118019	********
1977	3619055	*********
1978	8451275	**********
1979	7955915	**********
1980	29144716	**********
1981	23692375	**********

SOURCE: MONTANA DEPARTMENT OF STATE LANDS.

FIGURE 5: AVERAGE BONUS PER ACRE RECEIVED FOR LEASES OF STATE-OWNED OIL AND GAS, 1961-1981

YEAR	AVERAGE BONUS	
1961	1.011251	***
1962	1.381972	****
1963	2.526257	********
1964	.8052415	**
1965	1.493695	****
1966	.9248658	***
1967	1.368225	****
1968	6.175776	**********
1969	1.521316	*****
1970	1.204495	***
1971	.6611255	**
1972	.6499099	**
1973	1.259450	****
1974	1.616520	*****
1975	2.164620	*******
1976	.5273881	*
1977	3.816655	**********
1978	5.928950	**********
1979	8.041133	**********
1980	24.23779	**********
1981	14.10860	**********

SOURCE: Data from Montana Department of State Lands; Computation by The Meadowlark Group.

FIGURE 5: AVERAGE BONUS PER ACRE RECEIVED FOR LEASES OF STATE-OWNED OIL AND GAS, 1961 - 1981

YEAR	AVERAGE BONUS	
1961	.5112512	*
1962	.8819723	**
1963	2.026257	******
1964	.3052415	*
1965	.9936954	***
1966	.4248658	*
1967	.8682249	**
1968	5.675776	******************
1969	1.021316	***
1970	.7044952	**
1971	.1671255	
1972	.1499099	
1973	.7594501	**
1974	1.116520	***
1975	1.664620	*****
1976	.5273881	*
1977	3.816655	************
1978	5.928950	*******************
1979	8.041133	*************************
1980	24.23779	**
1981	14.10860	**

SOURCE: Data from Montana Department of State Lands; Computation by The Meadowlark Group.

FIGURE 6: NUMBER OF LEASED STATE-OWNED ACRES WHICH PAID DELAY DRILLING PENALTIES

YEAR	ACRES	
1960	189383.2	**********
1961	175896	**********
1962	160762.4	**********
1963	153461.6	**********
1964	158511.2	**********
1965	185164	**********
1966	199985.6	**********
1967	147653.6	**********
1968	117208	********
1969	104008	*******
1970	83587.2	*****
1971	76939.2	*****
1972	136311.2	*********
1973	190704	**********
1974	359544.8	**********
1975	427141.6	**********
1976	431094.4	**********
1977	420658.4	**********
1978	739908	**********
1979	913455.2	**********
1980	999278.4	**********
1981	1131725.	**********

SOURCE: Data from Montana Department of State Lands; Computation by The Meadowlark Group.

FIGURE 7: ROYALTY INCOME ON MONTANA STATE OIL AND GAS LEASES, 1960 - 1981

YEAR	ROYALTIES	
1960	617016	*****
1961	442371	***
1962	403282	***
1963	390895	***
1964	424008	***
1965	429718	***
1966	570976	****
1967	531812	****
1968	488890	****
1969	682546	*****
1970	561144	****
1971	578339	****
1972	590469	*****
1973	769527	******
1974	1284735	**********
1975	1681435	**************
1976	2077792	*****************
1977	2362827	********************
1978	2981660	*************************
1979	2882969	************************
1980	4276996	************************************
1981	9440454	**

SOURCE: Montana Department of State Lands.

FIGURE 8: PRODUCTION OF OIL ON STATE-OWNED LEASES, ACTUAL AND ESTIMATED, 1961-1980, IN BARRELS.

YEAR	BARRELS OF OIL	
1961	1380637	**********
1962	1281061	*********
1963	1227856	*********
1964	1332581	**********
1965	1349849	**********
1966	1782361	*************
1967	1635857	************
1968	1482875	**********
1969	1952350	**************
1970	1532544	**********
1971	1492080	**********
1972	1480875	**********
1973	1629940	**********
1974	1763217	************
1975	1674533	**********
1976	1845702	*************
1977	1928314	**************
1978	1663967	**********
1979	1602019	**********
1980	1700489	**********

SOURCE: Actual production, 1978, 1979, and 1980, Montana Department of State Lands.
Estimates by The Meadowlark Group.

FIGURE 9: PRODUCTION OF NATURAL GAS ON STATE-OWNED LEASES, ACTUAL AND ESTIMATED, 1961 - 1980, in MCF

YEAR	GAS PRODUCTION IN MCF (Thousands of cubic feet)	
1961	2788173	**********
1962	2240313	********
1963	2082405	********
1964	2129795	********
1965	2217123	********
1966	2997905	**********
1967	2674112	**********
1968	1909535	*******
1969	3338971	**********
1970	2788948	**********
1971	2944753	**********
1972	2763830	**********
1973	4492816	**********
1974	4281922	**********
1975	3696288	**********
1976	3744384	**********
1977	3400028	**********
1978	3769423	**********
1979	3919025	**********
1980	3624719	**********

SOURCE: Actual production, 1978, 1979, and 1980, Montana Department of State Lands. Estimates by The Meadowlark Group.

III. POLICY ANALYSIS

POLICY OBJECTIVES

There is a consistent and unequivocal thread running from the Enabling Act through the State Constitution to the Laws of Montana with respect to the State's responsibility in managing the public school lands. In disposing of land or an interest in the land, it must secure the full market value of the estate or interest disposed of (Enabling Act). In exercising its authority over the care, management, and disposition of state lands, the guiding rule and principle is that these lands and funds are held in trust for the support of education and for the attainment of other worthy objects helpful to the well-being of the people of this state. The board shall administer this trust to secure the largest measure of legitimate and reasonable advantage to the state (Title 77, MCA).

Within this context, the policy objective may be seen as having several facets:

1. With respect to disposal of state lands, the state must secure the full market value of the estate or interest disposed of. This directly applies to the setting of the state's royalty share of production.

2. In exercising its care and authority over lands, the board honors the spirit of the permanent trust and the support of education by managing the lands in a way which earns current income for the support of education while preserving and protecting the land's capability to produce future income. This applies to both surface and sub-surface aspects of the resource.

3. The state has an obligation to the school income and interest fund in setting the terms and conditions of leasing. All income, whether royalties, rentals, bonuses, or delay drilling penalties, eventually are translated into operating income for the public schools.

POLICY ISSUES

The policy objectives are quite clear and explicit. But within the policy objectives, there are issues which must be addressed by the board in determining how the policy objectives are best satisfied through specific operational measures.

Full Market Value. Because the land belongs to the permanent trust, its sale must obtain for the state its full market value. Income from the sale of state land is dedicated to the permanent trust fund, where the principal is inviolate. In the oil and gas industry, the primary policy variable available to the state is the royalty share of production, which the lessee must pay the state.

Full market value suggests a determination of value in a marketplace--where similar assets are sold by willing sellers to willing buyers, where neither buyer nor seller controls the market, where buyers and sellers are relatively free to enter or exit the market, and where there is a common base of information about the asset being sold.

Appraisers of real property typically evaluate property values in three ways: costs of a replacement or substitute; income-producing potential; and recent market history in similar sales.

In today's economy, while an individual may choose to heat a home electrically or ride the bus, the major identified direct substitute for natural gas or crude oil is synthetic fuels--an uneconomic technology in today's economy. An individual entrepreneur will surely estimate the income-producing potential of a lease under a specified royalty rate, but the variations of individual economics combined with the risk of finding a paying resource deposit and the uncertainty of future market prices make this very difficult to adequately address.

This leaves the analysis to focus on the marketplace for oil and gas leases, and to examine recent sales information to try to place Montana's resources in context with others.

Thus, the comparison with other lessors in this economic region becomes very relevant to the assessment of Montana's leasing policy.

Permanent Trust Versus Income. The permanent trust is served by the royalty rate assessed for production of state-owned resources. But if a competitive market exists for oil and gas leases, with many informed potential buyers, then it is reasonable to expect that the potential buyer will examine the full cost of acquiring and developing the lease in the context of risk, uncertainty, and potential return on investment. He will then adjust his bonus bid in such a way that he can expect to earn a fair rate of return on his investment. All other things being equal, an inverse relationship between royalty rates and bonus bids is entirely consistent with both economic theory and typical investor behavior. Because the bonus bid is the only factor in the bidder's control at the auction, he will reduce his maximum bid if his expected profits are diminished in any way. Once he has acquired a lease, then he must make other decisions, such as whether to keep, sell, or cancel the lease; drill on the property; defer a decision based on an expectation that conditions (prices, outcome of neighboring exploration) might change; and so forth.

As was pointed out above, the Board has an obligation to benefit the public schools through both income and the permanent trust. A major policy issue facing the Board is how to address the trade-offs between current income (in the form of bonuses, rentals, and penalties), and revenues to add to the permanent trust fund (royalties). Interestingly enough, both are felt as additions to operating income, with the trust being a long-term addition to operating income in the form of interest earned by the permanent trust fund.

ANALYTICAL APPROACH

While the subject at hand is an exceedingly complex one, the analytical approach is relatively straightforward.

First, the public sector context of state leasing is established. This includes the legal framework, financial structure, and policy framework for the management of state-owned resources. Then state oil and gas leasing is placed in the context of the oil and gas industry at large; the state, national, and global marketplace as well as state and national regulation and the countless other forces at work in the private sector.

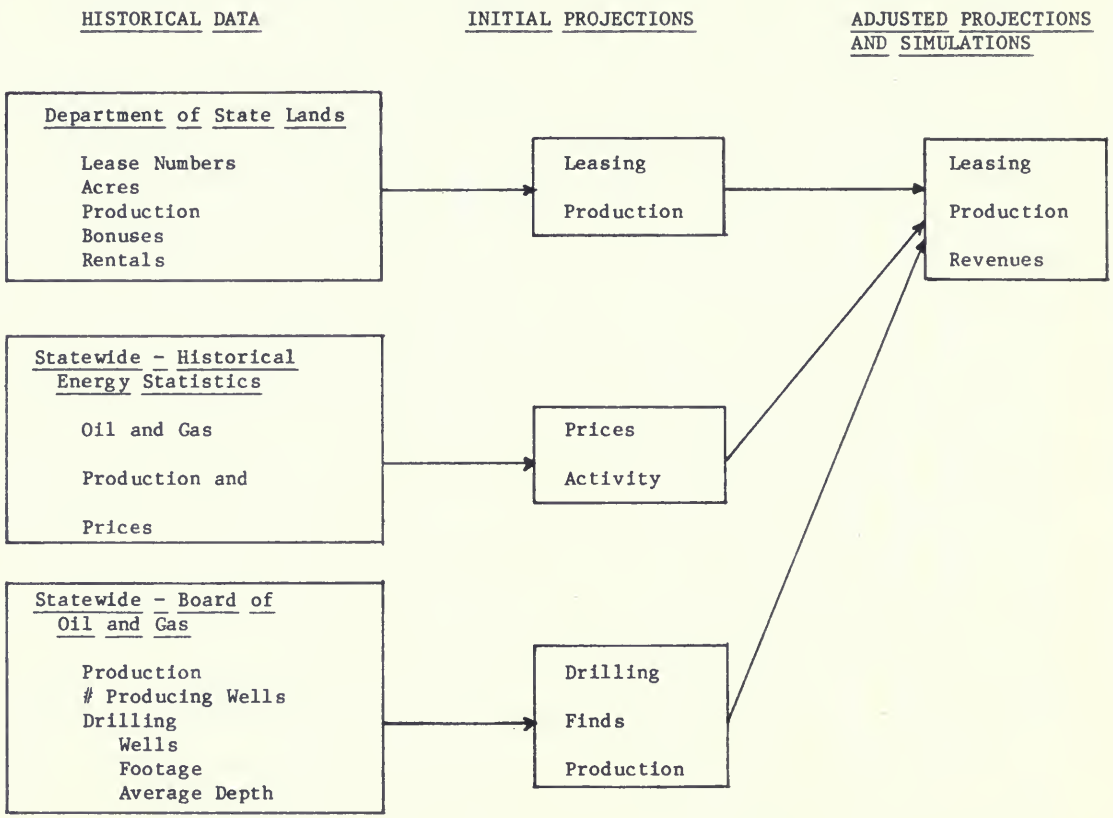
Then an approach for numerical analysis of present policies and possible alternatives is developed and present policies are examined.

Policy alternatives are specified and discussed in relation to the powers of the board and possible consequences. These alternatives are then evaluated under various sets of explicit assumptions as to the response of key variables to various policy actions. The outcomes are expressed in terms of royalty and other income, and a discounted present value of contributions to the public school interest and income fund is calculated.

The analytical framework uses a large electronic spread-sheet program on a micro-computer, which allows asking various "what if" questions in an economical and speedy way.

The conceptual framework is outlined in the following figure. Specific analytical actions are described in Chapter VI, Analysis of Current Policies, and Chapter VIII, Analysis of Alternatives.

FIGURE 10: ANALYTIC APPROACH



IV. COMPARISON OF LEASING POLICIES AND CLIMATE FOR DEVELOPMENT

The oil industry lives in a very diverse economic and physical world. There are many differences in the leasing policies of states and other entities. Furthermore, there often are vast differences in the geology between states and within a state. States and counties within a state often tax the industry at different rates. These differences are important factors in the costs and profitability of doing business in a particular state.

This chapter examines some of the differences between Montana and other states and entities in the west. In the pages that follow, the following areas will be explored: leasing policies; taxation; production costs; and physical production itself.

LEASING POLICY COMPARISONS

Other States. Appendix D contains descriptive write-ups on the leasing policies of thirteen states or other entities. Table 1 is a summary of the key points from Appendix D.

From Table 1, Montana's oil royalty, by virtue of the sliding scale based on production, is slightly higher than some of the lands of the federal government and New Mexico, and all of the lands of Colorado and Idaho. Idaho, of course, has no petroleum production in the entire state. If one were to pick a typical royalty rate, it would be 16 2/3%. Oklahoma and Texas, two states with legendary production, have rates even higher than this.

Gas royalties tend to be the same or slightly lower. No entity has a lower royalty for gas than Montana. Of the fifteen royalty rates cited in Table 1, five are a flat 12.5 %, one is a sliding scale beginning at 12.5 %, and the remaining nine are 16 2/3 % or more.

Annual per acre rentals range from $0.10 on "unproductive" lands in New Mexico, to $5.00 in Texas. Typical rent is $1.00. About half collect rent on a producing lease, and half don't.

Entities with five versus ten year lease terms are about evenly split, with two big producers, Texas and California, having three year leases.

The delay drilling penalty, or an equivalent, is used by six of the thirteen entities studied.

It should be pointed out here that the column labeled Indian is representative of the minimum terms of current leasing practices. Higher royalties and rentals, as well as shorter lease terms are common in current leasing of Indian resources.

Some form of a competitive auction predominates as the method for lease acquisition, but there is about an even split between oral auctions and sealed bid competition. Two entities, the Bureau of Land Management, and the State of Wyoming use the "simultaneous filing" method, more commonly known as the lottery. In this system, one pays a filing fee to have your name in the drawing. If you're selected, you may pay the first year's rent and become the lessee. This has become quite a speculative endeavor, and there are companies specializing in signing people up for a service charge. The winner is often not in the oil business, but hopes to profit from selling the lease to a bona fide developer for a cash sum and an over-riding royalty. The over-ride is a share in the production of the lease, if it produces.

TABLE 1: LEASING POLICY COMPARISON

	Mont.	Fed	Fed-KGS**	Indian	CA	CO	ID	NM	NM-KGS**	ND	OK	SD	TX	UT	WY
Royalty Rate															
Oil %	12.5-25	12.5	12.5-25	16.7	16.7	12.5	12.5	12.5	16.7	16.7	18.7	16.7	25	16.7	16.7
Gas %	12.5	12.5	12.5-16.7	16.7	16.7	12.5	12.5	12.5	16.7	16.7	18.7	16.7	25	16.7	16.7
Annual Rental $ Per Acre (years 6-10)	1.50	1.00 (3.00)	2.00	1.25	1.00	1.00 (2.00)	1.00	.10-.25	1.00	1.00	.50	1.00	5.00	1.00	1.00
Rent Paid During Production?	yes	no	no	yes	yes	yes	no	yes	yes	no	no	no	no	no	yes
Lease Duration (years)	10	10	10	5	3	10	10	10	5	5	5	5	3	10	5
Delay Drilling Penalty or Equivalent?	$1.25 (6-10)	see rent	no	no	no	see rent	$1.00 (6-10)	rent doubles yrs 6-10		yes	no	no	no	no	no
Lease Acquisition Method *	O.A.	S.F.	S.B.	S.B.	S.B.	O.A.	O.A.	S.B.	S.B.	O.A.	S.B.	O.A.	S.B.	S.B.	S.F.

* OA: oral auction; SB: sealed bid; SF: simultaneous filing.

** Known Geologic Structure.

For further information and sources, consult Appendix D.

Survey of Fee Lease Terms. In the course of this analysis, it became apparent that there is no single source of credible current information on the terms and conditions of leases recently entered into on fee (private) lands. An interview survey was structured to develop an independent profile of the range and distribution of various lease terms on fee lands. The survey, while not based upon a random sample, was performed as follows. Nine persons identified by members of the internal review committee as knowledgable of leasing terms and activity were interviewed by telephone to determine pertinent information, broken down by either county or general oil-producing area. The information included low, high, and typical mineral-owners royalty; low, high, and typical initial consideration (bonus) for the purchase of a lease; annual rental per acre; and lease duration in years.

Those surveyed were primarily petroleum landmen with personal experience in buying fee leases in the various areas, usually on behalf of various clients. Two of the interviewees were involved in leasing in the capacity of representing land and mineral owners. Table 2 is a summary of the key findings of the survey.

To summarize Table 2, the 12.5% royalty is typical in all areas except the Williston Basin (the central and northern parts of the far eastern portion of Montana). In recent years, the majority of Williston Basin leases have been greater than 12.5%, with 1/6 (16.7%) being typical.

TABLE 2: PERTINENT TERMS OF OIL AND GAS LEASES ON FEE LANDS IN MONTANA

AREA	MINERAL OWNERS ROYALTY LOW	HIGH	TYPICAL	INITIAL CONSIDERATION LOW	HIGH	TYPICAL	RENTAL $/ACRE	TERM (YEARS)	COMMENTS
Williston Basin	12.5	18.75+	16.7	50	300	70-200	1.00	3-5	Notes 1 and 2.
Shallow Gas (Havre area)	12.5	12.5+	12.5	1	15	5-6	1.00	5-10	Note 3.
Sweetgrass Arch	12.5	12.5+	12.5	3	25	10	1.00	5	Notes 3 and 4.
Overthrust Belt	12.5	12.5	12.5	1	20	5-10	1.00	5-10	Note 5.

Note 1. Older leases are predominantly 12.5% royalty. The majority of new leases since 1979 have been more than 12.5, with 1/6 (16.7%) being typical. Rate is seldom greater than 1/6.
Note 2. Some royalties of 25% or higher have been seen in share ownership and small tract situations.
Note 3. About the only times that rates greater than 12.5 are seen are cases where the tract is close to producing wells
Note 4. Rates greater than 12.5% are sometimes seen in cases of smaller interests.
Note 5. The longer lease term is seen as important here.

SOURCE: The Meadowlark Group.

Several observations can be made from the survey. The annual rental of $1.00 per acre is almost universal. The major point of discussion between the landman and the mineral owner is the initial consideration, or "bonus" being offered for the lease. There's a saying in the industry, that the the royalty rate is for the optomist and the bonus is for the pessimist. This is a corollary to the old saying, a bird in the hand is worth two in the bush. Landowners typically look much more at the bonus than at either royalty rate or duration of the lease. The bonus represents a certain sum of cash immediately available to the lessor. Given that it was reported that only 5-10% of all leases are drilled, the focus on bonus seems to be very rational.

All areas except the overthrust reported seeing royalty rates greater than 12.5%, but outside of the Williston Basin they were the exceptions. Proximity to production, strong geologic or geophysical indications, or a small remaining tract in a block were reported reasons for higher royalty rates.

Several respondents noted that many landowners and landmen recognize the trade-off between royalty rate and bonus. The effect of this can be for a landowner's demand for a higher royalty rate to be bought off with a higher bonus. Some companies are very rigid in their policy of refusing to enter into a lease in excess of 12.5% royalty.

In the course of seeking information on fee leases, the Burlington Northern railroad, probably the largest private landowner in the state, was contacted. BN reported that they no longer enter into leases as such, but rather function as their own operating company, entering into farmout agreements with other mineral or lease holders to share the risk and develop their properties. A typical feature of such a farm-out agreement is terms which change when a successful well reaches payout. Although typically expressed in terms of working interest before and after payout, the effect is not unlike a

two-tiered royalty rate. Before the well pays back its costs (reaches payout), the mineral owner participates at a lower rate, say 12.5%. Following payout, which is a commonly understood concept in the industry, the mineral owners working interest, or "royalty" will usually increase to a higher level, such as perhaps 25% or more. The terms of farmout agreements are typically tailored to the particular patterns of mineral ownership and the financial needs and capabilities of the parties to the agreement.

TAXATION COMPARISONS

In addition to federal taxation, the oil and gas industry is subject to several different taxes imposed under the laws of Montana at the state or local levels. This discussion is based on the "Report of the State Department of Revenue," for the biennium ending on June 30, 1980.

Net Proceeds. Net proceeds is defined as the annual gross value of the product of mines less certain deductions, plus the price paid the U.S. government for the mineral property. Net proceeds are intended to serve as a measure of the value of a mining property. The regular mill levies of the taxing district in which the property lies are assessed. Oil and gas properties as well as other mineral properties, except coal and metal mines, come under these provisions. The taxable value of the assessment of net proceeds is 100% of market value.

Royalties. Royalties from mineral production are also taxable at 100% of market value. In the case of oil and gas, royalties are assessed to and taxes are paid by the operator in behalf of the royalty owner. Other royalties are assessed directly to the owner and taxes are paid by him. The State of Montana, as a royalty owner, does not pay taxes on its royalty earnings.

License and Severance Taxes. In addition to the property taxes paid on the assessments listed above, operators pay certain license and severance taxes to the state. Oil producers pay 5.00% of the gross value of all oil produced. This increases to 6.00% April 1, 1983. The royalty share of production on State, Federal, and alloted Indian production is not subject to the severance tax. Natural gas producers pay 2.65% of the total gross value of production from each well.

Oil and gas producers also pay a severance tax to defray the expenses of the Oil and Gas Conservation Commission. It is 2/10 of 1% of the market value for each barrel of oil. The same rate applies to each 10,000 cubic feet of

natural gas.

Finally, all nonrenewable resource producers pay the Resource Indemnity Trust Tax of $25 annually, or 0.5% of the gross value of their production over $5,000, whichever is greater. The proceeds of this tax are to be used for environmental protection and improvement.

In addition, if the operator is a corporation, then a corporate income tax is payable to the state.

For purposes of comparisons with other states, there are two other types of taxes which may be paid by the oil industry in other states. First is a sales tax, which Montana does not have. This would apply to the purchases of machinery and equipment used in oil and gas operations. The second may be called a franchise tax, or a capital values tax.

In June of 1981, the California Assembly Office of Research published a report entitled "State Taxation on the Production of Crude Oil: A Comparison of Nine States." This document is the major reference for this study's comparison of taxation with other oil-producing states.

According to the California report, Montana ranks 13th among the states in terms of annual oil production, but ranks first (that is, imposes the highest tax burden) among the nine states studied.

The California report specified two hypothetical corporations, and then calculated the tax burden for each for each of the nine states studied. The key comparison tables as well as a description of the hypothetical corporations can be found in Appendix E at the end of this report. Table 3 is taken from the California report.

TABLE 3: EFFECTIVE TAX RATES LEVIED ON THE PRODUCTION OF CRUDE OIL IN NINE OIL-PRODUCING STATES, FY 1982

STATE	Effective Severance Tax Rate	Effective Ad Valorem Tax Rate	Total Effective Tax Rate	Difference With Montana
Montana	4.86	10.50	15.36	.00
Louisiana	11.80	.00	11.80	3.56
Wyoming	5.60	6.00	11.60	3.76
North Dakota	5.93	5.00	10.93	4.43
Alaska	9.60	.00	9.60	5.76
New Mexico	7.19	.00	7.19	8.17
Oklahoma	7.09	.00	7.09	8.28
Texas	4.60	.00	4.60	10.76
California	2.50	.00	2.50	12.86

SOURCE: "State Taxation on the Production of Crude Oil: A Comparison of Nine States," Assembly office of Research, California State Legislature, June 1981.

PRODUCTION COSTS

The costs of drilling and equipping a well depend on many factors, including the depth and material being drilled, difficulties with access or weather, costs of labor, interest, materials, level of taxes, and so forth.

Table 4, below, presents cost indices and drilling costs for selected years for the U.S. drilling industry.

TABLE 4: U.S. DRILLING COSTS AND COST INDICES

	Cost Indices (1967 = 100)			Drilling Costs		
Year	Oil Field Machinery	Oil Well Casing	Field Wages	Total (Thous. $)	Per Well	Per Foot
1960	91.3	91.6	82.8	2425000	54900	13.01
1965	95.2	96.2	93.2	2401437	60648	13.44
1970	118.4	109.1	117.8	2578682	94885	18.84
1975	196.3	211.5	186.2	6571214	177793	36.99
1978	261.2	271.6	249.8	13061000	279950	56.63
1979	289.7	285.2	270.3	6078930	331367	67.70
1980	335.3	327.4	336.2	N.A.	N.A.	N.A.

SOURCE: "The Oil Producing Industry in Your State," The Independent Petroleum Association of America, 1981. Cited source there, cost indices from U.S. Bureau of Labor Statistics, and Drilling Costs from Joint Association Survey.

Table 5 presents a comparison of costs for nine western states and the U.S. Of the nine states, Montana was seventh in number of wells drilled, eighth in total footage drilled, and ninth in total cost of wells drilled. Montana's average well depth was eighth, average cost per well was eighth, and the average cost per foot was also eighth.

TABLE 5: ESTIMATED COST OF DRILLING AND EQUIPPING WELLS, 1979, A COMPARISON OF WESTERN STATES

STATE	WELLS DRILLED (Number)	FOOTAGE DRILLED (Thous. feet)	TOTAL COST (Thous. $)	AVERAGE DEPTH (feet)	AVERAGE COST PER WELL	AVERAGE COST PER FOOT	RANK
Montana	757	3024	158088	3994	208834	52.28	9
California *	1900	5591	405383	2943	213359	72.5	4
Colorado	1064	5412	218918	5086	205750	40.45	10
New Mexico	1586	9174	508367	5784	320534	55.41	1
North Dakota	442	3948	309858	9013	701036	78.48	3
Oklahoma	6286	32007	1911084	5091	304022	59.71	6
Texas *	14783	79132	4230523	5353	286175	53.46	8
Utah	272	1650	204801	6066	752944	124.12	1
Wyoming	1272	9777	933765	7686	734091	95.51	2
United States	48523	237512	16078930	4894	331367	67.7	5

* Excludes offshore activity

SOURCE: "The Oil Producing Industry in Your State," The Independent Petroleum Association of America, 1981.

PRODUCTION AND DRILLING SUCCESS

The production of oil and gas in Montana in the past twenty years has been characterized by peaks due to new discoveries. Crude oil production is pictured in Figure 11, where the all-time high production in 1968 was due to the Bell Creek discovery in the Powder River Basin. Appendix C contains a summary of statewide oil industry data, including oil and gas production and drilling information.

State natural gas production is pictured in Figure 12. Here the all-time peak production in 1973 followed the discovery of the Tiger Ridge field in north-central Montana a few years before.

Production depends on successful drilling, and successful drilling requires, first, the presence of resources, and second, a successful drilling program.

Table 7, which contains selected drilling figures for Montana computed from the data in Appendix C, looks at dry holes as a percent of developmental, exploratory, and all wells.

Table 6 presents Montana's drilling success over all time in relation to other western states. Of the ten states included, Montana ranks seventh in the number of wells drilled, fourth in the percent of wells that produced dry holes, third in the percent of wells which produced gas, and eighth in the percent of wells that produced oil. Interesting comparisons can be made from Table 6; for example, look at Montana versus Wyoming. Montana has only had 58 percent of the number of wells drilled that Wyoming has. In terms of dry holes, 48.8 % of all Montana wells have been dry holes, while 41.1% of those in Wyoming have been dry. Montana's percent of wells producing gas was about double Wyoming's level, and our percent of wells producing oil was seventy percent of Wyoming's level.

TABLE 6: TOTAL WELLS DRILLED FOR OIL AND GAS IN ALL TIME, TO JANUARY 1, 1981
(Excludes Service Wells) AND AVERAGE DAILY PRODUCTION

STATE	OIL		GAS		DRY		TOTAL	AVERAGE DAILY
	Number	Percent	Number	Percent	Number	Percent	Number	PRODUCTION (*)
Montana	8955	37	3416	14.1	11818	48.8	24189	22.7
California	94350	77.2	2733	2.2	24749	20.4	120932	20.7
Colorado	7696	26.8	4104	14.3	16879	58.8	28679	23.8
New Mexico	25349	50.7	13682	27.3	10904	21.8	49935	13.1
North Dakota	3601	49.4	39	.5	3645	50	7285	46.1
Oklahoma	202671	60.8	34035	10.2	96132	28.8	332838	5.1
South Dakota	122	15.1	19	2.3	662	82.4	803	20.3
Texas	418113	59	55645	7.8	233994	33	707752	15.1
Utah	2335	39	777	12.9	2869	47.9	5981	48.3
Wyoming	21790	52.2	2766	6.6	17150	41.1	41706	34.2
United States	1492384	57.7	280657	10.8	795144	30.7	2584324	15.9

(*) Barrels of crude oil per well at the end of 1980.

SOURCE: "The Oil Producing Industry in Your State," The Independent Petroleum Association of America, 1981.

TABLE 7: SELECTED DRILLING FIGURES, MONTANA

YEAR	DEVELOPMENTAL WELLS DRILLED (DWD)	DRY HOLES AS A PERCENT OF DWD	EXPLORATORY WELLS DRILLED (EWD)	DRY HOLES AS A PERCENT OF EWD	TOTAL DRY HOLES	DRY HOLES AS A PERCENT OF ALL WELLS DRILLED
1961	235	25.53	182	95.05	233	55.88
1962	255	22.35	164	93.90	211	50.36
1963	197	30.46	165	92.12	212	58.56
1964	216	50.46	175	85.71	259	66.24
1965	293	36.52	214	92.99	306	60.36
1966	284	33.80	198	93.43	281	58.30
1967	280	37.14	203	94.09	295	61.08
1968	403	22.08	537	94.79	598	63.62
1969	320	32.81	486	95.88	571	70.84
1970	153	41.18	295	92.20	335	74.78
1971	119	28.57	348	92.82	357	76.45
1972	263	33.08	461	94.36	522	72.10
1973	311	32.15	408	89.71	466	64.81
1974	449	47.22	293	90.44	477	64.29
1975	588	37.76	257	91.83	458	54.20
1976	539	31.35	248	89.92	392	49.81
1977	506	37.15	172	75.00	317	46.76
1978	578	40.14	215	83.26	411	51.83
1979	537	33.89	266	79.32	393	48.94
1980	650	31.69	302	86.09	466	48.95

SOURCE: Data from Montana Board of Oil and Gas Conservation.
Percentage computations by The Meadowlark Group.

FIGURE 11: CRUDE OIL PRODUCTION, 1942-1980

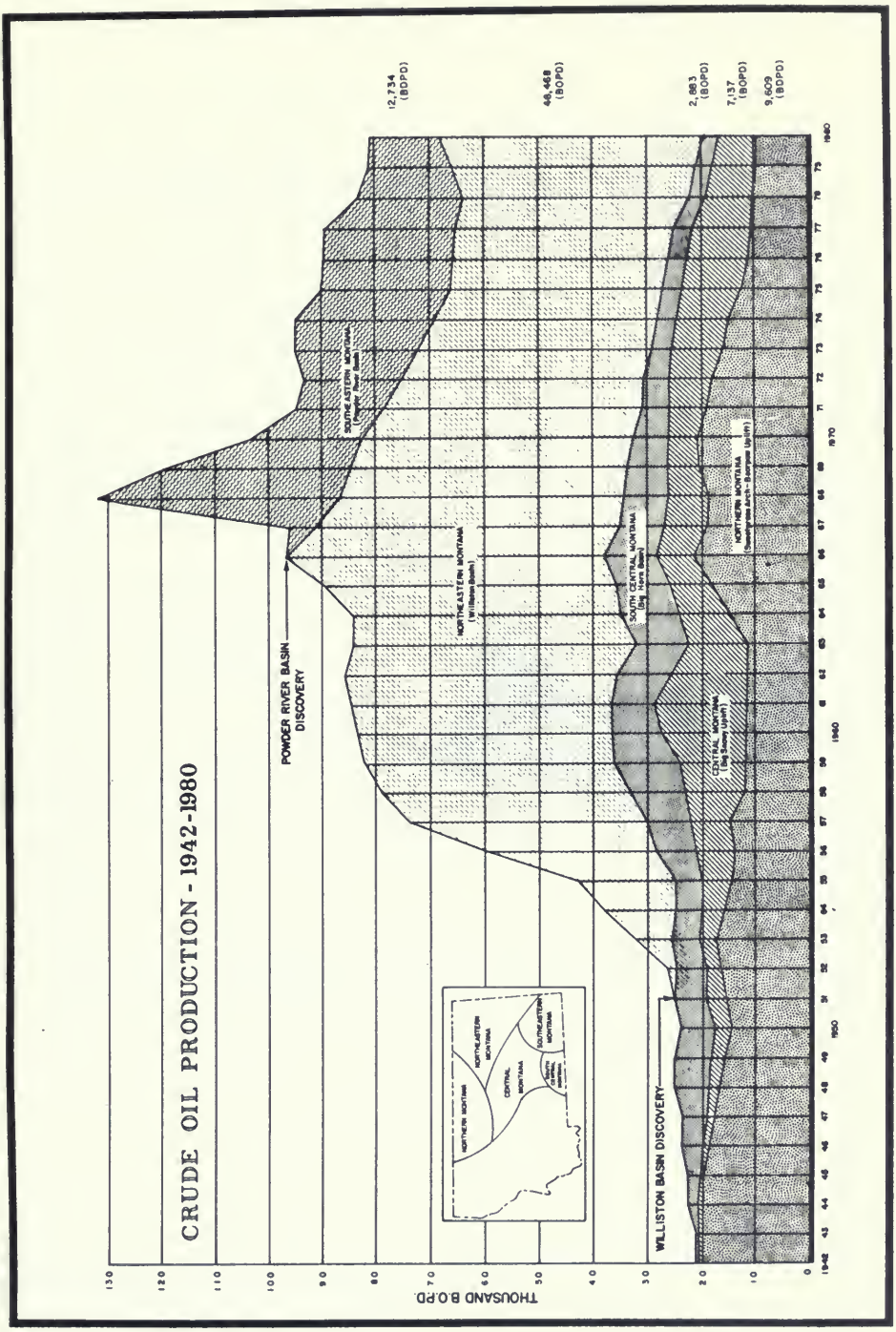
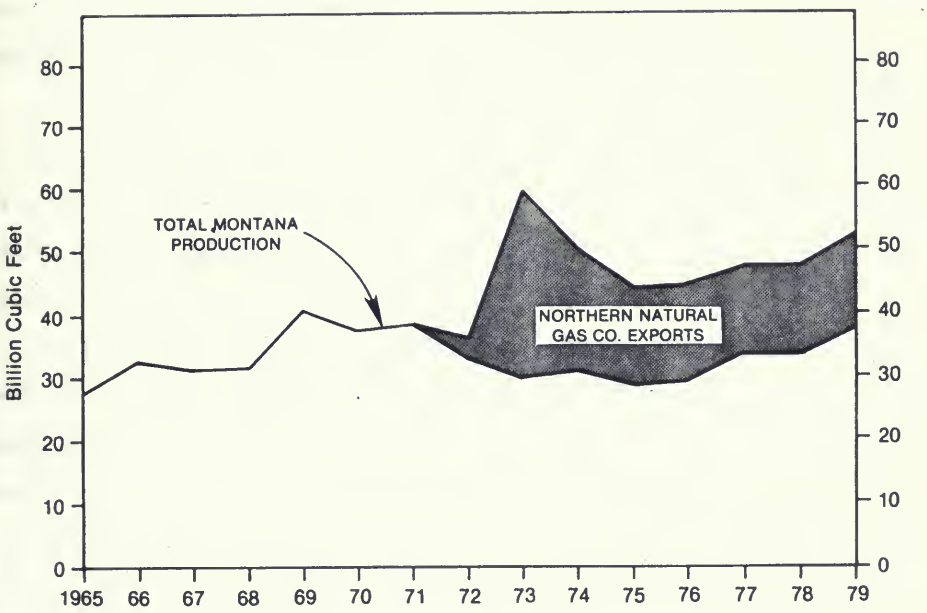


FIGURE 12: MONTANA NATURAL GAS PRODUCTION AND EXPORTS, 1965-1979



SOURCE: Montana Department of Natural Resources and Conservation, Historical Energy Statistics, Volume 4, October 1980.

V. DETERMINANTS OF LEASING AND DEVELOPMENT: AN ECONOMIC DECISION

The leasing of lands for oil and gas development is an element of a very complex and interactive economy. Numerous factors enter into a bidder's thought process in approaching a lease auction. The same can be said for a lessee's decision to drill a state tract. This chapter presents an overview of the rationale in evaluating a petroleum prospect, which is the basis for the decision to drill a tract. While time and information rarely allow a bidder to perform the same level of analysis at the point of the lease auction, the bidding is a reflection of the expected value of the tract.

From the perspective of the Board of Land Commissioners, it is important to try to understand how a change in some aspect of the state leasing policy will affect industry activity. It is true, however, that beyond any state leasing policy action, there are numerous factors which may be much more important in the bidders' overall evaluation.

As the various factors of influence are discussed, it is noted that many, including the most influential, are outside the control of the Board of Land Commissioners. Furthermore, most are also outside the control of the Legislature as well.

Once a quantity of oil or gas has been taken from the ground, its economic path is not unlike most other modern industrial activities. Transportation, processing, and distribution can be accomplished with relative certainty. Capital outlays, operating costs, and expected returns can be addressed with a knowledge and precision similar to numerous other manufacturing or utility enterprises. But the facet of the industry which directly relates to leasing--the purpose of this investigation--is vastly different. This is the drilling of exploration and development wells. Large capital outlays are required before one can even know if any return whatsoever will be

forthcoming, much less be able to economically evaluate the prospects. In recent years in Montana, 75-90% of all exploratory wells drilled were dry holes. Even for developmental wells, 30-40% were dry holes in recent years. (See Table 7, page 37.)

The oil exploration and development industry in Montana today is an important part of the state economy, but at its foundation it is an art as well as a science. The industry embodies the science (and art) of exploration geology, petroleum engineering, and geophysics; the negotiating skills of landmen in assembling leases into developable blocks; the blessings of the supreme being who may or may not have placed resources under a particular lease; favorable production costs and market prices; and, after all of the above, a little luck.

Large sums can be expended for geology, geophysics, lease bonus payments, and lease rentals prior to the drilling phase. In 1979 the average cost of drilling a well in Montana was $208,834, and the average cost in the U.S. was over $330,000. Applying an estimated factor of a fifteen percent rise per year, this would bring Montana's 1982 average well cost (assuming similar average wells) to over $317,000 per well. This average well cost cannot be considered representative of the costs of a deep exploratory well in Western Montana's overthrust belt. Reported costs there range from four to eight million dollars or more per well. All of this must be balanced against the chances for success.

Rational industry decision-makers compare the costs of acquiring and exploring a number of prospects with the potential for a return on only a percentage of the wells drilled. This high degree of risk is a peculiarity of the industry, and places the very high rate of return of very successful wells in context.

Return on investment is the standard measure by which an investor evaluates a potential investment, and compares one with another. The rational investor will identify all expected costs, and compare them with expected returns, to determine a rate of return on the investment. If the expected rate of return is not competitive with investment alternatives, then it will not be pursued. Investors have numerous alternatives in placing funds. If the potential return on investment does not look good in the oil industry, there are investment opportunities outside the industry. Investors who specialize in oil can look at state, federal, tribal, or private properties in Montana, and similarly in other states. In each case the opportunities, the costs, and the risks are considered.

The rational investor will incorporate risk into the calculations. For example, if the expected probability of a successful well is one in five, an individual well will be drilled only if the expected return on a successful well is five times what would otherwise be expected in a less risky endeavor. On average, this allows the costs of four dry holes to be recovered when a successful well is found on the fifth try.

Figure 13 has been included to demonstrate how risk can be incorporated into the evaluation of an investment in a gas well. The figure portrays exploration economics for a hypothetical "typical" Oklahoma gas well. The term "discovery ratio for break even" means that in 1970, primarily due to low prices, one in three wells needed to be successful in order to break even. With the price increases which had occurred by 1979, and in spite of increases in all cost categories, the ratio had gone to 12:1. This figure is included only to demonstrate the incorporation of risk into an analysis. These are not specific values for Montana.

FIGURE 13: EXPLORATION ECONOMICS, "TYPICAL" WESTERN OKLAHOMA GAS WELL

Year	Cost Item	Costs	Revenue	Discovery Ratio for Break Even
1970	Drilling Cost	$150,000		
	Operating Cost	30,000		
	Royalties (12.5%)	85,000	4,000,000 Mcf	Profit $373,000
	Prod. Taxes (7%)	41,700	@ $.17 per Mcf	Risk 150,000
	Total	$306,700	$680,000	Ratio 3:1
1979	Drilling Cost	$430,000		
	Operating Cost	77,000		
	Royalties (22%)	1,760,000	4,000,000 Mcf	Profit $4,773,000
	Prod. Taxes (12%)	960,000	@ $2.00 per Mcf	Risk 430,000
	Total	$3,227,000	$8,000,000	Ratio 12:1

SOURCE: Venita Van Caspel, Money Dynamics for the 1980s, 1980.

Figure 14 reflects how the expected return on investment is influenced by several factors. A plus (+) sign indicates that the factor would experience an increase, while a minus (-) sign indicates a decrease. Thus, if risk were to decrease, expected return on investment would increase. If taxes were to increase, expected return on investment would decrease.

FIGURE 14: The Relationship Between Expected Return on Investment In Oil and Gas Development and Several Influencing Factors.

Expected Return on Investment	Increase (+)	Decrease (-)
Risk	-	+
Lease Cost: rentals, royalties, bonuses, penalties	-	+
Market price for oil or gas	+	-
Drilling costs	-	+
Production costs	-	+
Taxes	-	+
Regulatory costs - dollars and time	-	+
Transportation available?	yes	no
Friendly lease terms?	yes	no
Developable block?	yes	no

SOURCE: The Meadowlark Group.

The first six factors in Figure 14 are discussed in various places throughout this report. The last four factors are discussed below.

Regulatory Costs. Regulations on the industry, whether for environmental protection, worker safety, or public safety, translate into costs to be initially borne by the industry. It is not the purpose here to explore the basis for regulation, but it should be noted that the argument in favor of regulation is that doing so is an effective way of causing the industry to bear its fair share of costs or risks it imposes on its workers and the public at large. From the industry perspective, however, it is sometimes argued that various governmental regulations increase the operating costs of industry and make it more difficult to compete.

In the case of state leases, there does not appear to be any particular burden of regulations over and above those normally encountered by the oil industry in doing business in Montana. In contrasting Montana with other states, the same appears to be the case. Industry personnel seem to be satisfied with the regulation of the oil and gas producing industry as carried out by the Board of Oil and Gas Conservation.

Transportation. The availability of a means of transporting the oil or gas produced from a new well can be a very important factor to the developer. This is particularly the case with respect to gas. The only practical way to transport gas from the well to the consumer is by pipeline. Pipelines can be very costly, particularly if a substantial distance is required. The number of wells served is important to the economics of the pipeline, because its costs must be justified based on the quantity of gas it will carry. The availability or expected availability of a gas pipeline is an important factor in the value of a lease where one might expect to produce gas.

The transportation of oil is not so highly dependent upon pipeline availability, because oil lends itself to movement by truck and/or rail as

well.

Friendly Lease Terms. There are many leasing practices in the industry which are essentially standard practice. It is true, however, that each lease is a contract between the mineral owner and the lessee, and as such virtually any term can be negotiable. It is possible for the mineral owner to make demands which make the lease less desirable to the developer. For ease of exposition, these are called "unfriendly" lease terms. Examples might include restrictions on surface occupancy or uses, more detailed reporting procedures, unlimited on-site use of produced gas by the lessor, and so forth. Indications are that the current leasing practices of the Department of State Lands are in the friendly category.

Developable Block. It is standard industry practice to assemble a block of land of sufficient size to protect the investment in drilling before drilling commences. This is called assembling a developable block. It is not uncommon to have a block nearly completed, and to have to negotiate with a landowner for the final piece of the block. In cases such as this, where the developer has a substantial investment in the balance of the block, it may be worth more to him to acquire the final piece than it was to acquire the first one. On a per-acre basis this can particularly be the case with a tract that is either quite small (say an acre or so) and/or in split ownership. Industry representatives have reported that state tracts tend to be acquired in the latter stages of assembling a block rather than at the outset.

An examination of the history of state leasing, including acres leased, new acres leased, and bonuses, shows that these measures of leasing activity parallel two driving factors very closely. The first is the real price of oil and gas, and the second is the occurrence of a major discovery. See Figures 2, 3, 5, 11, and 12, and Table 8. Table 8, on the following page, expresses oil and gas prices, bonuses, and some other measures in constant 1982 dollars.

Figure 15, below, classifies some of the important determining factors on the basis of the level of control exercised by the Board of Land Commissioners and the Legislature.

FIGURE 15: FACTORS AFFECTING OIL AND GAS LEASE REVENUES TO THE STATE OF MONTANA

Under Board Control	Outside Board of Land Commissioners Control	
	Under Legislative Control	Outside Montana Control
Royalty Rate Above 12 1/2%	State taxes	Market
Rental Rate Above $1.50	State Regulations	State, nation, world Competition Prices
Delay Drilling Penalty Above $1.25, in years 7 through 10	Lease terms: duration (years) royalty rates rentals penalties	Drilling success Drilling costs National taxes

SOURCE: The Meadowlark Group

TABLE 8: KEY FINANCIAL DESCRIPTORS OF STATE LEASING EXPRESSED IN CONSTANT 1982 DOLLARS

YEAR	CPI-W	INFLATOR	OIL PRICE	GAS PRICE	CONSIDERATION	BONUS	AVERAGE BONUS	ROYALTIES
1960	88.70	3.22	7.96	.21				1989477
1961	89.60	3.19	7.76	.21	1023637	514682	3.23	1412032
1962	90.60	3.16	7.61	.20	1092870	634061	4.36	1273054
1963	91.70	3.12	7.61	.20	1640021	1174933	7.88	1219149
1964	92.90	3.08	7.51	.20	1407668	627901	2.48	1305342
1965	94.50	3.03	7.38	.20	1271883	761843	4.52	1300522
1966	97.20	2.94	7.18	.21	989754	475560	2.72	1680032
1967	100.00	2.86	7.06	.23	1230135	710701	3.91	1520982
1968	104.20	2.74	6.94	.23	14515236	12492425	16.95	1341867
1969	109.80	2.60	6.93	.21	3478140	2098646	3.96	1777852
1970	116.30	2.46	6.86	.19	1411507	771221	2.96	1379941
1971	121.30	2.36	6.93	.19	702103	279436	1.56	1363602
1972	125.30	2.28	6.89	.21	1761303	693789	1.48	1347758
1973	133.10	2.15	7.35	.28	2719164	1515701	2.71	1653529
1974	147.70	1.94	10.32	.40	2728304	1685582	3.13	2487706
1975	161.20	1.77	12.99	.57	1551412	1061175	3.84	2983191
1976	170.50	1.68	13.69	.70	1257098	327011	.88	3485329
1977	181.50	1.58	13.84	.91	3029700	2174924	6.01	3723243
1978	195.30	1.46	13.46	1.13	6380001	5091797	8.68	4366384
1979	217.70	1.31	15.13	1.34	5246246	4421463	10.56	3787456
1980	247.00	1.16	23.93	1.37	28250537	26604094	28.06	4952311
1981	272.30	1.05	33.04	2.19	18502799	16724665	14.82	9915424
1982	286.00	1.00	32.94	2.32				

SOURCE: The Meadowlark Group.

VI. ANALYSIS OF CURRENT POLICIES

The current leasing policies of the Board of Land Commissioners are described several places in this report, including Chapter II and Appendix D. To summarize, the royalty rate for oil production is 12.5% of the gross value of production up to 3,000 barrels per month. Production between 3,000 and 6,000 barrels per month pays 17.5%, and production in excess of 6,000 barrels per month pays 25%. Gas is a flat 12.5%. Annual rental is $1.50 per acre and must be paid even if the lease is producing. The lease period is for ten years, which is extended if the lease is producing, or if it is in a unit. A delay drilling penalty is assessed in years six through ten unless the lessee is diligently drilling the tract or the lease is producing. Leases are acquired through an advertised oral public auction, with bidding on a "bonus" basis, the minimum bid being the first year's rental.

As discussed in Chapter III, current and alternative policies were examined using a computer model which calculated various characteristics for the period 1983 to 2000. All relationships were explicitly stated, as were pertinent assumptions. Assumptions were based on extensive discussions with persons knowledgable about the petroleum industry, as well as with the help of the petroleum engineer on the project team.

The variables and assumptions are discernible by reviewing Appendix F, which includes the output from the simulation of current policies.

The pertinent assumptions are as follows: oil prices will remain constant in real dollars, as will operating costs. State leasing will reach a ceiling of 5.5 million acres in 1983, and remain at that level through the analysis period. Leases will turn over at an annual rate of one million acres per year. Acres paying delay drilling penalties will stabilize at one million acres per year. Average bonus will be $10 per acre, the permanent trust fund

will earn 2% per year in real earnings, and the discount rate for bringing the stream of annual interest and income figures to the present is 3.5%.

The model of current policies was structured to formally consider an allocation of oil and gas production (important for royalty estimation) to wells existing at the beginning of FY 1983, from post-1983 wells producing from leases in effect prior to 1983, and from leases entered into after the beginning of FY 1983. These assumptions for production are shown in Figures 16 and 17. While the substance of these figures is difficult to predict with precision given the limitations of accessible data on production by leases, they were used to make the analytical assumptions very clear. They serve as the benchmark from which expected leasing and production responses to possible policy changes are measured.

To summarize the analysis, at the end of FY 2000, the trust fund balance attributable to oil and gas lease revenues from 1983 on is estimated to be $192.3 million. The 1983 present value of the interest and income stream is $265.6 million. Present value of bonuses is estimated to be $131.9 million, and present value of royalties is estimated at $135 million.

FIGURE 16: OIL PRODUCTION ON DSL LEASES: OLD AND NEW WELLS, OLD AND NEW ROYALTY RATES.

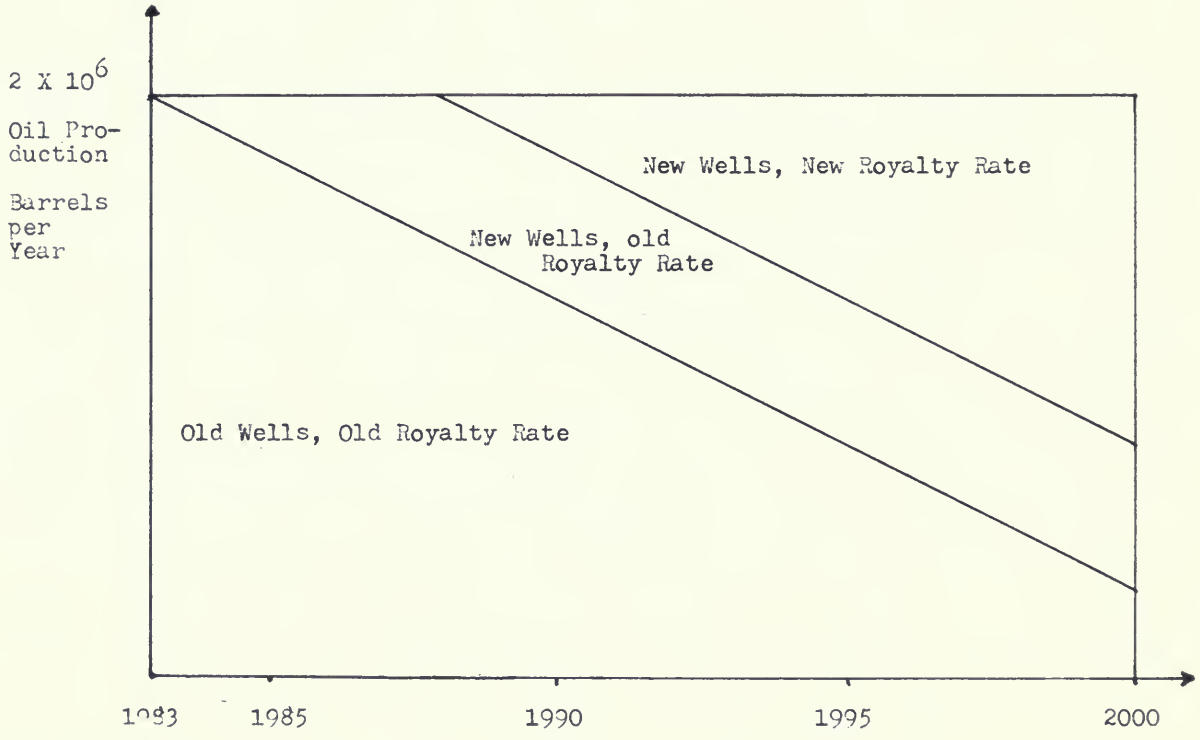
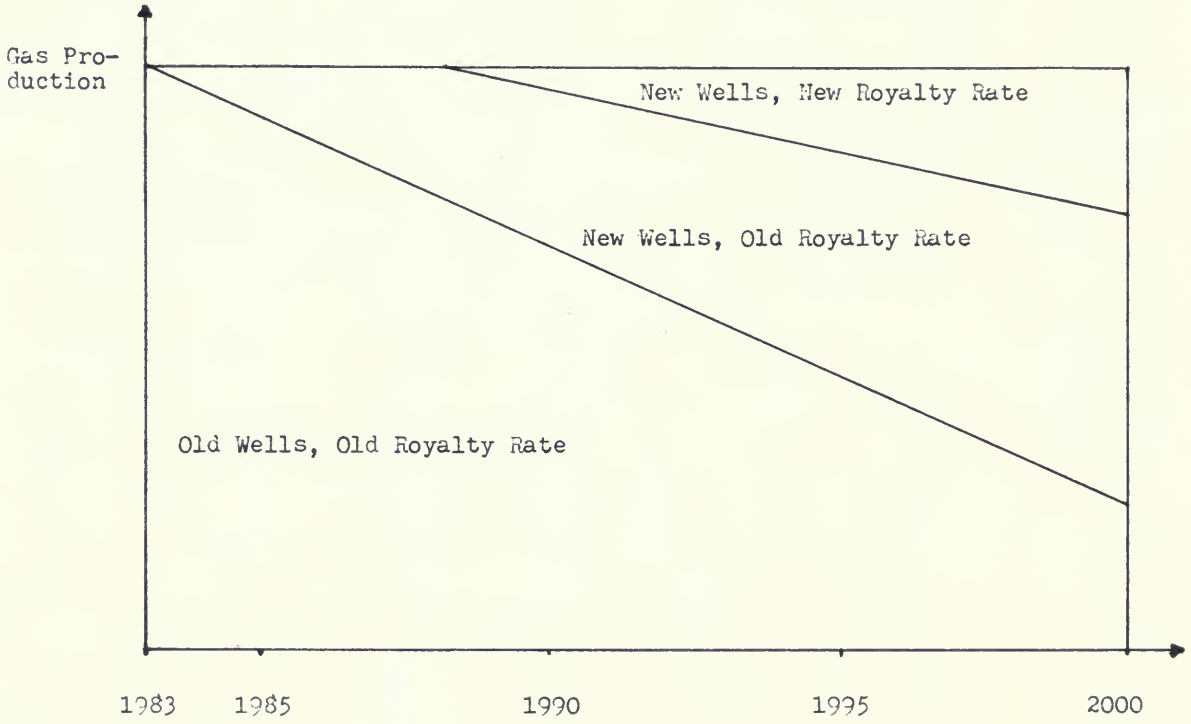


FIGURE 17: GAS PRODUCTION ON DSL LEASES; OLD AND NEW WELLS, OLD AND NEW ROYALTY RATES.



VII. IDENTIFICATION OF ALTERNATIVES

Based on the examination of leasing policies of other entities, and discussions with parties familiar with the industry, the following alternative policy measures have been identified for evaluation.

A. Change Royalty Rates.

1. Current Rates. The current rates are 12.5% for gas and a stepped schedule for crude oil based on production, and going from 12.5 to 17.5 to 25 percent.

2. Alternative Rates.

	Oil	Gas
a.	15%	15%
b.	16 2/3 %	16 2/3 %

State law has set minimum royalty rates at 12.5% on oil and gas, but the Board has the authority to set higher rates.

B. Change lease term duration.

Change lease term from current ten year term to five years. Eliminate delay drilling penalties.

C. Change lease acquisition method.

The following lease acquisition methods were considered:

1. Simultaneous Filing (lottery) - along the lines of BLM and Wyoming.

2. Sealed bid versus oral auction.

D. Separate policy for known production areas

In known geologic structures, a resource appraisal could be performed, and a minimum bid established.

E. Increase Delay Drilling Penalty

In order to encourage drilling on state leases, or to encourage those not willing to drill to relinquish the lease so that others could obtain it, delay drilling penalties in years seven through ten could be increased. The analysis examines a doubling of delay drilling penalties in years 7 through 10, an increase from $1.25 per acre to $2.50.

The Legislature has set the delay drilling penalty for year six at $1.25 per acre, and the Board has the authority to set the penalties higher for subsequent years.

F. Different terms for different areas.

Because of significantly higher drilling costs or risk, policies to encourage activity could be adopted. Examples of such circumstances include very deep wells and the overthrust belt. Policies could include reduced royalties, and so forth.

G. Variable Royalty Rate--Lower in first years of production.

A lower rate in the early years of production to provide greater incentives for exploration and production. The policy considered is 12.5% for the 24 month period following initial production, increasing to 16.67% thereafter.

CHAPTER VIII. ANALYSIS OF ALTERNATIVES

ELASTICITY

Elasticity is an economic term which has important implications for the quantitative evaluation of different leasing policies in this analysis. Elasticity is the numeric ratio of the percent change in one variable over the percent change in another. The most commonly used elasticity is the price elasticity of demand. If an X% increase in price of a commodity resulted in a Y% decrease in the demand for it, then the price elasticity would be (+X)/(-Y), or -X/Y. If the commodity were gasoline, and the price increased from $1.00 to $1.05, five percent, and the demand dropped from 100 million gallons to 95 million, five percent, then the price elasticity of demand for gasoline would be one. An elasticity of 1.0 is called unitary elasticity.

In looking to the future for oil and gas leasing activity on state lands, several questions arise regarding the response of development activity to changes in policies. The key concerns are: 1. The elasticity of acres leased to a change in royalty rates, delay drilling penalties, or duration of the lease. 2. The elasticity of delay drilling penalties to an increase in the delay drilling penalty rate. 3. The elasticity of bonus bids in response to an increase in royalty rates and/or delay drilling penalties. 4. The elasticity of production in response to an increase in royalty rates.

The approach used in the analysis has been two-fold. First, every effort has been made to acquire primary data which might reflect the market for oil and gas leases in Montana and our region, including examining changes in the level of leasing on other entities' properties in response to changes in their leasing policies. Secondly, the energy and economic literature has been searched for examples of elasticity rates from other studies which might serve to aid this study in establishing assumed levels for sensitivity analysis.

This has been done, but in the professional opinion of the author, the numbers which have been identified, such as national estimates for the long-run elasticity of demand for energy delivered to the consumer in the transportation sector (motor gasoline) are not applicable to the instant case. The real market which must be examined is how do State of Montana leases stack up against federal, private, and tribal leases in Montana, and against these plus other state leases in other states around us. It is reasonable to expect that one could calculate a derived demand for oil leases, based upon the demand for oil or the major oil product, gasoline. However, this would be an economy-wide estimate. It would be very useful in estimating the overall effect that rising prices would have on the demand for oil leases. It would not, however, be of value in looking at Montana State Leases in relation to other alternative oil and gas leases.

For the information of the reader, the following table summarizes the range of estimates of elasticity from a major national survey of several detailed econometric studies.

TABLE 9: ESTIMATES OF LONG-RUN ELASTICITY OF ENERGY DEMAND

Sector	Range of Studies	Most Likely Range
Residential	0.28 to 1.10	0.7 to 1.1
Industrial	0.49 to 0.90	0.8 to 0.9
Transportation (Motor gasoline)	0.22 to 1.3	0.7 to 1.0

SOURCE: "Energy: The Next Twenty Years," report by a study group sponsored by the Ford Foundation and administered by Resources for the Future. Cambridge: Ballinger Publishing Co., 1979.

Having been unsuccessful in finding empirical estimates of the price or royalty elasticity of demand for oil leases, even in an aggregate setting, a

surrogate elasticity was postulated. In recent years, significant public attention has focussed on the existence and level of severance taxation on the mineral industry. A severance tax is a percentage of the value of the mineral production, typically based on the gross value of production at the mine mouth. After adjustments for other forms of taxation which may interact with the severance tax in determining the total tax burden, a percentage increase in severance taxes is essentially similar to an increase in the royalty rate. A study of the economic impact of a severance tax on Kentucky coal (Harvey and Karst, 1972) discussed the factors determining whether the demand for Kentucky coal was elastic or inelastic. It concluded: 1. The more easily other inputs can be substituted for coal, the more elastic will be the demand; 2. The greater the price elasticity of demand for the final product which the coal helps to produce, such as electric power or steel, the greater the price elasticity for the coal; 3. The greater the supply elasticity for other inputs, the greater the demand elasticity for coal; 4. Demand is unlikely to change greatly in response to small changes in input costs if they represent a relatively small portion of production costs; and 5. The price elasticity of demand for coal is likely to be greater in the long run than in the short run.

For purposes of analysis, the threshold elasticity assumed for models subsequent to Model B, has been 1.0. The analytical format allows the adjustment of independent variables in simulation runs.

ANALYSIS OF ALTERNATIVES

Each alternative specified in the preceding chapter has been evaluated for any advantages or disadvantages it might have in replacing a current leasing policy of the Board of Land Commissioners. The evaluation process typically involved identification and discussion of expected developments as a

result of the policy change. The alternative is then considered in relation to the policies of other states, as well as federal, tribal, and fee leases. Where appropriate, policy changes have been analyzed in the model to quantify the effects of the policy on revenues.

A. Change Royalty Rates. The two alternatives specified embody two categories of effects. The first is due to the elimination of the progressive crude oil royalty rste based on monthly production in favor of a flat rate.

On the surface, it would appear that the progressive (stairstepped) rate would stand to benefit the state's royalty take, while at the same time avoiding the disadvantages to the producer and lessor of an excessive royalty forcing an earlier arrival at economic cut-off. However, this doesn't appear to be the case, based on an inspection of the data on leases currently paying more than 12.5% royalty on crude production. Data prepared by the Department of State Lands indicate that in FY 1980 there were five leases reporting production at the higher levels. Three had production bringing them into the 17.5% range, and two reached the 25% range. For the three leases in the 17.5% category, the production at the higher rate ranged from 7 to 25 percent of total production. Monthly production reports on the other two leases show from zero to 22 percent of production at the 25% rate, and 20 to 38 percent at the 17.5% royalty rate.

Totaling all leases for 1980, the weighted average oil royalty was 12.97 percent, due to production under the stepped rate schedule. A case can be made for the progressive schedule being somewhat burdensome on wells typical of the Red River Formation, where initial production occurs at a very high level, quickly followed by a significant decline during the first year of production.

An inspection of production records on the leases cited suggests there may be some conscious management of production to avoid the highest royalty

rates. Such behavior is legal and certainly could be of benefit to the lessee. There doesn't seem to be a case for eliminating the stepped schedule without an increase in the base rate, as this would be a reduction from an acceptable level with no off-setting adjustment.

The second set of effects is a function of the royalty rate itself.

A Higher Royalty Rate.

Increasing the royalty rate to 15% or 16.67% would be expected to affect lessee behavior and aggregate performance in the following ways.

1. As was described in the survey of fee leases, the average bonus would be expected to be somewhat less. The rational bidder will expect to realize a smaller return on a successful well under a higher royalty rate schedule, so the bid will be less.

2. Current unexpired leases, which will retain the older (lower) royalty rate, will become somewhat more valuable for development or exchange. The expected increase in their value is due to the fact that any production on these leases will be at the former rate. Lessees who are not in a position to develop a lease themselves may find it easier to sell or farm out a state lease than before, because the margin of difference between the former and new rates allows room for bargaining. A new lease-holder will face the higher rate under a new state lease, so it would be advantageous to arrange an agreement between the current lease-holder and the new party, rather than allow the lease to terminate and be re-sold. A higher royalty rate would be expected to increase the rate of holding of current leases.

3. The level of leasing at auction sales would be expected to decline somewhat. Other things being equal, the state leases will be marginally less appealing than they were under the former lease terms.

4. Under a higher royalty rate, wells at a point of very low production or wells in a marginal status will reach the point of economic cut-off sooner. This has the effect of reducing royalty income and does not maximize the total production which could come from wells in this category. This impact would be countered if the state were to adopt a stripper well policy as mentioned in Chapter X, Concluding Comments.

5. Other things being equal, tracts under a higher royalty rate would be drilled later than others or, in some cases, not drilled at all. This is not deemed a major factor in the context of all the determinants of drilling.

6. Since the State of Montana is a major land-holder in Montana, it is possible that an increase in royalty rates by the State would have the effect of tending to boost the royalty rate on fee leases. Montana is a part of the market. Over the long run, policies of all entities are subject to change.

The timing of the effects cited above and their interaction should be

noted. A tempering of average bonus would be felt upon implementation of the policy change, as would the effects on holding current leases and a reduced interest in state leases. Any effect on the point of economic cut-off would be felt many years into the future, as reflected by Figure 16, showing production under the new royalty rate. The effects of drilling tracts under the new rate would begin to be felt about five years after policy adoption.

Any discussion of the effects of a royalty rate increase must recognize the present status of state leasing. Montana's state lands are nearly all leased up. The Meadowlark Group estimates a practical maximum of 5.5 million acres under lease, which is only 3-400,000 more than currently leased. At the present time, approximately 95% of the state's leasable acres are under lease. This fact has played a central part in the analysis of the effects of a policy

One important characteristic of state, federal, and tribal leases, in contrast with fee leases, should be noted. As discussed in the taxation comparisons in Chapter IV, production from these three categories of lands is not subject to Montana's oil or natural gas producers severance tax or the net proceeds tax. While this does not give these tracts an advantage over fee leases for the lessee, it does have the effect of increasing, sometimes substantially, the actual royalty earnings which accrue to the mineral owner.

Industry representatives will argue that the cumulative effect of Montana's level of taxation of the industry along with a hike in the royalty rate will be excessive. Industry actors with experience are very conscious of Montana's level of taxation. Where a company has essentially similar opportunities in two states, other things being equal, the level of taxation will make the difference. Not only that, but industry representatives have

noted that they are more accepting of higher royalty rates in other states, where the level of taxes is lower.

The focus of this analysis has been on royalty rates and other terms of the leasing policy of the State of Montana, rather than an evaluation of Montana's taxation of the oil and gas industry. The Board of Land Commissioners should recognize that the effects of an increase in royalty rates will be closely inter-related with the level of taxation.

Fifteen Percent.

In a comparison with other entities, a 15% royalty rate comes out somewhere in the middle. In contrast with the royalty rates received in other states, where the typical level is 1/6 (16.67%), 15% is slightly lower. In comparison with fee leases in Montana, 15% is lower than the typical rate in the Williston Basin, but higher than the "standard 1/8" found throughout most of the rest of Montana. Tribal leases are typically 1/6 or more, but many in the industry are very critical of tribal lease terms. Some advertised tribal lease sales have had few and in some cases no bidders because of the terms. Federal leases of the non-KGS variety, allocated through the simultaneous filing process (the lottery), have a mineral-owners royalty of 12.5%. It must be pointed out, however, that with hundreds of thousands of persons filing for these leases, most of whom are probably not bona fide oil developers, one would expect a much higher level of over-riding royalty interests. Policy-makers should ask the question, is it preferable to give a windfall to a lucky speculator, or to capture the value of the resource through a competitive auction with people who are seriously in the business. The effects of over-rides on leases are essentially similar to an increased mineral-owners royalty in many respects. To the ultimate developer, each is a claim on production which lessens the value of his working interest.

16.67 Percent.

In comparison with other entities, a 16.67% royalty rate is slightly on the high side. It is comparable with what other states now receive, notably Montana's neighbor states of North Dakota, South Dakota, and Wyoming. In comparison with fee leases in Montana, it is comparable with the typical royalty rate in the Williston Basin, but is higher than the "standard 1/8" found throughout the rest of Montana. It is comparable with tribal lease terms and higher than the non-KGS "simultaneous filing" leases of the federal government. Each of the six effects identified in the general discussion of a higher royalty rate, above, should be expected to have a more pronounced effect under the 16.67% rate than would be experienced under the 15% rate.

The combined effect of a 16.67% royalty rate and Montana's state and local taxation begins to be substantially greater than at 15%. The combined effect can be estimated by summing Montana's royalty rate and the net tax difference (advantage) over Montana found in Table 3. As pointed out above, the purpose of this investigation is to look at lease terms, not taxes, but as the proposed royalty rate gets larger, the combined effect of the royalty rate and taxes shouldn't be ignored.

B. Change Lease Duration. Changing the lease duration from ten to five years would have the following effects.

1. The rate of turnover of leases entered into after the policy change would increase.

2. State leases would become less desirable, especially in areas where more time is required to assemble a block and drill, such as the overthrust belt.

3. Average bonuses would probably be reduced somewhat.

4. Drilling would occur sooner after lease sale on new leases.

This alternative would eliminate the need for delay drilling penalties on regular leases, so they would be dropped as a matter of automatic policy for

new leases. The delay drilling penalty clause would still be included in the lease agreement, however, so that in cases of units or perhaps in other instances the state would retain the option of imposing the penalty.

In comparison with other areas, the trend is toward shorter lease terms, with our neighbors North Dakota, Wyoming, and South Dakota all having a five year lease term. Many fee leases are now five year leases, with some less. Industry representatives interviewed in the fee lease survey indicated that a period of time greater than five years was important in difficult areas, such as the overthrust.

C. Change Lease Acquisition Method.

Simultaneous Filing. This approach would be similar to the process used by the federal government and the State of Wyoming. It is quite difficult to predict with any certainty how this policy would affect the revenues of Montana. A recent study (McDonald, 1979) spoke to the benefits and costs of the simultaneous filing system,

"The upshot is that in most cases lands that later turn out to be productive are acquired noncompetitively, and large windfalls of pure economic rent accrue to the original lessees or their assigns. Such windfalls do not alter the margin of profitable exploration and development, and it would be better economically if they could be captured by the government and used to displace equivalent taxes."

In further addressing the matter of government revenues through filing fees, the report goes on to say,

"But substantial application fees are no satisfactory justification for noncompetitive leasing. In the first place, the Department of the Interior has no way of knowing whether such fees in the aggregate amount to as much as could have been derived from competitive leasing bonuses. While fee receipts may be higher than possible bonuses on relatively poor prospects, the reverse is almost certainly true for relatively good prospects."

This study added that not only does the lottery system produce less revenue for the mineral owner, but it also "significantly increases the resource costs of getting lands into the hands of oil and gas operators."

Sealed Bid Versus Oral Auction. Evaluation of the current method of an oral

auction in contrast to using sealed bids is not so clear-cut. There is a typical pattern of behavior for bidders at an auction. That is to open the bidding at substantially less than the maximum one would be willing to pay. When there is bona fide competition, with multiple bidders who enjoy an understanding of the value of the item being auctioned, then the bidding quickly moves above the (sometimes ridiculously low) opening bid, and bidders drop out at their pre-determined maximum is reached and exceeded. While the final winner may not have to pay his maximum price, in a competitive situation his maximum will only be incrementally greater than the second-place bidder. Thus, a successful oral auction requires competition, which is characterized by numbers of interested bidders with similar information bases.

The sealed bid approach offers both advantages and disadvantages to the state and to bidders. On the plus side for the state, bidders must determine their own maximum offer, and then make a judgment as to how close to it they will come in submitting their written bid. In cases where competition was lacking with oral auctions, this would tend to garner for the state higher bids. Where there is relative certainty, bids by different parties should be fairly close to each other. Where there is substantial uncertainty, or where parties gamble by making a ridiculously low bid, there can be a wide margin between bids received. On the plus side to the bidder, persons who actually have decision-making authority in a firm do not have to be present at the auction. To contribute to the competitive quality of the auction, bidders do not know the identity of their competition. Sealed bidding tends to be less emotional than oral auctions.

On the negative side, sealed bidding can place the smaller operator or firm at a disadvantage, since he doesn't know if he is going to end up acquiring leases on all or none of his bids. In contrast, in the oral

auction, one can set a maximum limit in terms of purchases, and knows when to stop bidding.

D. Separate Policy for Known Production Areas. Under this policy, areas with unique characteristics could be separated out and treated differently in the leasing process. For example, extremely deep wells might be given a break to compensate for the greater cost of drilling, which affects the risk factor. Another example might be establishing a minimum bid in known structures, along the lines of the assessment which is performed on all federal KGS leases. Another possibility in a framework of separate policies, might be a lease agreement along the lines of a farm-out agreement, where the state's royalty interest would be at one level, say 12.5%, until a well reached payout, and would increase to some significantly higher level for the balance of the life of the well, such as perhaps 25%.

Advantages.

1. Greater flexibility in tailoring terms to unique situations would probably make some marginal or difficult to develop properties feasible. Clearly, the high risk associated with very expensive drilling is a deterrent to drilling.

2. Incentives could be provided through the adjustable rate (a la farm-out), which would enhance and accelerate the recovery of the investment in the well by the lessee. Such an incentive would be expected to increase the level of drilling on state tracts.

3. A benefit to the state of performing a resource assessment is that a foundation level for its value could be established, and the states interest could be protected from accepting bids which severely undervalue the resource.

Disadvantages.

1. Each of these ideas place significant demands on the resources of the Department of State Lands to administer them. A resource assessment is a highly technical analysis which must be done correctly if it is to have value. An adjustable royalty rate before and after payout requires that the Department have the power and the staff to audit lessees books to certify when the point of payout is reached. If payout is defined for accounting purposes in an overly broad fashion, then the state could stand to lose substantial sums.

2. It is difficult to ascertain exactly at what points thresholds would be defined, so as to fairly and rationally administer the resources. For example, if the state tried to implement a policy which resembled the fee leasing

patterns of the williston basin, then as activity picks up in an area, the royalty rates would increase. Unfortunately, looking at history suggests that by the time the activity really picks up, most of the tracts have already been leased. This leavea, in general, the tracts which developers felt were the least desirable in passing them over before. Thus we could end up with the absurd policy of setting higher royalty rates on the least desirable tracts, just because they were within the broad vicinity of some production.

E. Increase Delay Drilling Penalty. Increasing the delay drilling penalty as described above would be expected to have the following effects.

1. Drilling on current leases would increase. The effect of the penalty is to make it more costly for a lessee to sit on a lease without developing it. This also has a combined effect with a royalty rate increase, in that both tend to make the existing leases look more attractive to drill now, in relation to the same tract leased under a higher royalty rate.

2. The holding of current leases would be discouraged. Because of the financial penalty for non-development, lessees would be inclined to not sit on current leases they were not serious about developing. This does not mean, however, that lessees would choose to allow their leases to terminate. Again, there is a combined effect with a higher royalty rate which would encourage lessees to either farmout or sell their leases, which retain the lower royalty rates, rather than simply let them terminate.

3. While one might expect that average bonus would be reduced, discussions with knowledgable persons in the industry leave the impression that reduction in bonuses will be negligible.

4. Similar to (3), above, one might expect the increase to reduce the level of leasing, but given the noticable trend toward five year lease terms on both fee leases and on the leases of our neighboring states, this will probably be a negligible effect.

F. Different Terms for Different Areas. This alternative is a corollary to alternative (D) above, a separate policy for known production areas. For example, very deep wells, or a specific geological province such as the overthrust belt might be identified by the Department, and reduced royalties or the adjustable royalty before and after payout might be applied. The advantages and disadvantages of this alternative are essentially similar to those discussed under alternative (D).

G. Variable Royalty Rate - Lower in First Years of Production. This alternative would provide some particular benefits to the lessee and some particular costs to the state.

1. The lessee would enhance his chance of reaching payout, and of reaching it sooner, with a lower initial royalty rate.

2. Under the pattern of production exhibited by many of the Red River Formation wells in the Williston Basin, a lower rate in the first year or two of production would be particularly advantageous to the producer, since many of these wells exhibit extremely high production levels in their first months of production, and then experience a significant decline and leveling off.

3. The principle disadvantage to the state is the loss of potentially significant revenues. The potential gain to the lessee is taken from the potential loss to the state.

4. A higher royalty rate in the period of a well's declining production is antithetical to the conservation of the resource. It would contribute to a premature decision to terminate production, by bringing the point of economic cut-off sooner. This alternative is contrary to the logic used in the comment on a stripper well policy in Chapter X.

MODEL RESULTS, RECOMMENDED POLICY

The returns due to changing the royalty rate from the current schedule to a flat 15% were analyzed using the analytical model found in Appendix G. The model is an adjustment of the current policies model from Appendix F. The pertinent differences are a reduction in average bonus to $9.85, a 15% new royalty rate, and a 10% production decline under the new royalty rate in the year 2000.

To summarize the results, at the end of FY 2000, the trust fund balance attributable to oil and gas leases from 1983 on is estimated to be $194.6 million. The 1983 present value of the interest and income stream is $263.9 million. Present value of bonuses is estimated to be $129.9 million, and present value of royalties is estimated at $136.8 million.

IX. RECOMMENDATIONS

Based on the preceding analysis of current and alternative policies, the following policy actions are recommended to the Board of Land Commissioners.

1. Eliminate the current sliding scale royalty for crude oil and establish the royalty rate for oil and gas at 15%.

2. Double the per acre delay drilling penalties in yeers seven through ten, from $1.25 per year to $2.50 per year. This action should be made effective one year from the date of the decision, with notice going out to all lease-holders. Retain the ten year lease term.

3. Retain the oral auction method of lease acquisition. Publish quarterly the list of leases which have terminated.

The rationale for the recommendations can be found in the executive summary.

X. CONCLUDING COMMENTS

Department of State Lands Records

Regarding the records kept by the State of Montana on state leasing activities, three comments need to be made.

1. By agreement of all who have worked with them, their quality is first rate. The information contained in them has been scrupulously entered and the records have been safely maintained.

2. The manual system now being used is severely strained due to the very high level of leasing.

3. As the Department of State Lands automates its data base, it should keep in mind the kinds of analyses it would find useful in doing the best possible job of managing the over six million leasable acres of lands for which it is responsible.

Stripper Well Policy

If the Board of Land Commissioners increases the royalty rate, then it should consider adopting a policy wherein operators of stripper wells (wells with very low production) could petition for and, if appropriate, be granted a lower royalty rate (probably 12.5%). Such a policy would help the state schools through extending production and royalties, would contribute to less waste of oil because wells would produce longer, and would be of benefit to lessees as well.

APPENDIX A.

The Laws of Montana. The specific administration of State lands is addressed in Title 77, MCA, "State Lands."

Chapter 1. "Administration of State Lands"

77-1-202. Powers and duties of board. The board shall exercise general authority, direction, and control over the care, management, and disposition of state lands and, subject to the investment authority of the board of investments, the funds arising from the leasing, use, sale, and disposition of those lands or otherwise coming under its administration. In the exercise of these powers, the guiding rule and principle is that these lands and funds are held in trust for the support of education and for the attainment of other worthy objects helpful to the well-being of the people of this state. The board shall administer this trust to secure the largest measure of legitimate and reasonable advantage to the state.

History: En. Sec. 3, Ch. 60, L. 1927; re-en. Sec. 1805.3, R.C.M. 1935; amd. Sec. 1, Ch. 113, L. 1969; amd. Sec. 1, Ch. 67, L. 1973; amd. Sec. 3, Ch. 428, L. 1973; R.C.M. 1947, 81-103(part).

77-1-203. Multiple-use management. (1) The board shall manage state lands under the multiple-use management concept defined as the management of all the various resources of the state lands so that:

(a) they are utilized in that combination best meeting the needs of the people and the beneficiaries of the trust, making the most judicious use of the land for some or all of those resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions and realizing that some land may be used for less than all of the resources; and

(b) harmonious and coordinated management of the various resources, each with the other, will result without impairment of the productivity of the land, with consideration being given to the relative values of the various resources.

(2) If a parcel of state land in one class has other multiple uses or resource values which are of such significance that they do not warrant classification for the value, the land shall, nevertheless, be managed insofar as is possible to maintain or enhance these multiple-use values.

History: (1)En. Sec. 3, Ch. 60, L. 1927; re-en. Sec. 1805.3, R.C.M. 1935; amd. Sec. 1, Ch. 113, L. 1969; amd. Sec. 1, Ch. 67, L. 1973; amd. Sec. 3, Ch. 428, L. 1973; Sec. 81-103, R.C.M. 1947; (2)En. Sec. 16, Ch. 60, L. 1927; amd. Sec. 8, Ch. 428, L. 1973; amd. Sec. 1, Ch. 8, L. 1974; Sec. 81-302, R.C.M. 1947; R.C.M. 1947, 81-103(part), 81-302(part); amd. Sec. 6, Ch. 15, L. 1979.

77-1-301. Powers and duties of the department. (1) Under the direction of the board, the department has charge of the selecting, exchange, classification, appraisal, leasing, management, sale, or other disposition of the state lands. It shall perform such other duties the board directs, the purpose of the department demands, or the statutes require.

(2) It shall collect and receive all moneys payable to the state through its office as fees, rentals, royalties, interest, penalties, or payments on mortgages or lands purchased from the state or derived from any other source. It shall issue a receipt for each cash payment or whenever requested by the payer.

History: En. Sec. 8, Ch. 60, L. 1927; re-en. Sec. 1805.8, R.C.M. 1935; amd. Sec. 2, Ch. 26, L. 1971; Sec. 81-204, R.C.M. 1947; redes. 81-105 and amd. by Sec. 5, Ch. 428, L. 1973; R.C.M. 1947, 81-105.

Specific aspects of oil and gas leasing are addressed in Part 4 of Chapter 3, "Oil and Gas."

77-3-401. Oil and gas leases authorized. (1) The board is hereby authorized and empowered to lease in such manner as it may determine, not inconsistent with The Enabling Act and the constitution, any state lands to which the title has vested in the state and in which the oil and gas rights are not reserved by the United States, for prospecting and exploring for oil and gas, mining, drilling, developing, and removing the same upon the terms and conditions herein prescribed to any person, association, corporation, domestic or foreign, or municipality qualified under the constitution and the laws of the state.

(2) This power and authority to lease state lands for such purposes shall extend to and include all lands owned by the state under navigable lakes and streams and shall also extend to and include all those state lands which have been sold but in which the oil and gas rights have been reserved by the state; but in such cases and in all cases where the lands are under lease for grazing, agriculture, or similar purposes, care shall be taken in issuing the oil and gas leases to protect the rights of the purchaser or lessee.

History: En. Sec. 1, Ch. 108, L. 1927; re-en. Sec. 1882.1, R.C.M. 1935; amd. Sec. 1, Ch. 90, L. 1943; amd. Sec. 1, Ch. 261, L. 1947; amd. Sec. 6, Ch. 184, L. 1961; R.C.M. 1947, 81-1701(part).

77-3-402. Rules. (1) The board shall have the power and authority to prescribe such rules and to do and perform all acts and things not inconsistent with The Enabling Act, the constitution, and the statutes of this state as it may deem necessary and proper relating to the leasing of state lands for oil and gas exploration and development. The board shall formulate rules not inconsistent with law governing the leasing of state lands for oil and gas exploration and development which shall be compiled and printed periodically.

(2) Copies of the rules and notices of changes therein shall be made available to any person desiring a copy thereof at a reasonable cost to be fixed by a rule of the board.

History: En. Sec. 7, Ch. 108, L. 1927; re-en. Sec. 1882.7, R.C.M. 1935; amd. Sec. 1, Ch. 144, L. 1961; R.C.M. 1947, 81-1707.

77-3-403. Hearings on questions related to leases. The board is hereby granted full power and authority to order and hold hearings on any matter or question involving oil and gas leases under such rules as it may adopt.

History: En. Sec. 10, Ch. 108, L. 1927; re-en. Sec. 1882.10, R.C.M. 1935; R.C.M. 1947, 81-1710(part).

77-3-404. Limitation on area under single lease. An oil or gas lease issued on state lands may not embrace more than 640 acres, except that any section surveyed by the United States which contains more than 640 acres may be included under one lease.

History: En. Sec. 2, Ch. 108, L. 1927; amd. Sec. 1, Ch. 193, L. 1931; amd. Sec. 1, Ch. 171, L. 1933; re-en. Sec. 1882.2, R.C.M. 1935; amd. Sec. 1, Ch. 109, L. 1941; amd. Sec. 1, Ch. 91, L. 1943; amd. Sec. 1, Ch. 128, L. 1945; amd. Sec. 1, Ch. 122, L. 1953; amd. Sec. 84, Ch. 428, L. 1973; R.C.M. 1947, 81-1702(part).

77-3-405. Leased lands to be generally compact and contiguous. (1) The lands shall be leased in as compact bodies as the form and areas of the tracts held by the state and offered for lease will permit.

(2) No lease may embrace noncontiguous subdivisions of lands unless the subdivisions are within an area comprising not more than 1 square mile.

History: En. Sec. 1, Ch. 161, L. 1955; amd. Sec. 12, Ch. 22, L. 1971; amd. Sec. 85, Ch. 428, L. 1973; amd. Sec. 1, Ch. 136, L. 1974; amd. Sec. 1, Ch. 379, L. 1975; R.C.M. 1947, 81-1702.1(3).

77-3-406. Number of leases which one person may hold. Any person, association, corporation, or municipality qualified to hold an oil or gas lease on state lands may receive from the board or take through assignment or succession, will, judgment, decree, or otherwise through the operation of law more than one oil and gas lease to state lands, subject to such regulations and limitations as the board prescribes.

History: En. Sec. 2, Ch. 108, L. 1927; amd. Sec. 1, Ch. 193, L. 1931; amd. Sec. 1, Ch. 171, L. 1933; re-en. Sec. 1882.2, R.C.M. 1935; amd. Sec. 1, Ch. 109, L. 1941; amd. Sec. 1, Ch. 91, L. 1943;

77-3-421. Duration of lease. (1) All state oil and gas leases shall be granted for a primary term or period of 10 years and as long thereafter as oil or gas in paying quantities is produced, on condition that all drilling, rental, and other obligations are fully kept and performed by the lessee.

(2) Oil or gas produced from any part of a unit in which state lands are included by virtue of a pooling agreement are considered to be produced from the state lands therein within the meaning of this part.

History: En. Sec. 2, Ch. 108, L. 1927; amd. Sec. 1, Ch. 193, L. 1931; amd. Sec. 1, Ch. 171, L. 1933; re-en. Sec. 1882.2, R.C.M. 1935; amd. Sec. 1, Ch. 109, L. 1941; amd. Sec. 1, Ch. 91, L. 1943; amd. Sec. 1, Ch. 128, L. 1945; amd. Sec. 1, Ch. 122, L. 1953; amd. Sec. 84, Ch. 428, L. 1973; R.C.M. 1947, 81-1702(part).

77-3-422. Lease extension clause. If oil or gas is not being produced from the leased premises at the expiration of the primary term of the lease but the owner of the lease is then engaged in drilling on the premises for oil or gas, then the lease continues in force so long as such drilling operations are being diligently prosecuted. If oil or gas is recovered from any such well drilled or being drilled at or after the expiration of the primary term of the lease, the lease continues in force so long as oil or gas in paying quantities is produced from the leased premises.

History: En. Sec. 2, Ch. 108, L. 1927; amd. Sec. 1, Ch. 193, L. 1931; amd. Sec. 1, Ch. 171, L. 1933; re-en. Sec. 1882.2, R.C.M. 1935; amd. Sec. 1, Ch. 109, L. 1941; amd. Sec. 1, Ch. 91, L. 1943; amd. Sec. 1, Ch. 128, L. 1945; amd. Sec. 1, Ch. 122, L. 1953; amd. Sec. 84, Ch. 428, L. 1973; R.C.M. 1947, 81-1702(part).

77-3-423. Annual rental. (1) The annual money rentals to be paid to the state for oil and gas leases issued on and after July 1, 1975, shall be set by the board but may not be less than $1.50 for each acre of land leased.

(2) In addition to the sum of $1.50 per acre, the rental for the first year of the lease shall also include any sum in excess of $1.50 per acre offered and accepted for the first year's rental.

(3) This annual rental shall in no case be less than $100 a year.

(4) The first year's rental shall be paid before the issuance of the lease. The rentals for each subsequent year of the lease shall be due and payable before the beginning of such subsequent year, and upon failure to make such payment the lease terminates.

History: En. Sec. 1, Ch. 161, L. 1955; amd. Sec. 12, Ch. 22, L. 1971; amd. Sec. 85, Ch. 428, L. 1973; amd. Sec. 1, Ch. 136, L. 1974; amd. Sec. 1, Ch. 379, L. 1975; R.C.M. 1947, 81-1702.1(1), (2).

77-3-424. Power to terminate lease in absence of commencement of drilling or payment of delay drilling penalty. (1) In every oil and gas lease granted after March 3, 1955, under this part there shall be reserved to the board full power to declare termination of the lease at the end of the fifth year or any subsequent year of the primary term of the lease upon failure of the lessee to either:

(a) commence the drilling of a well for oil and gas upon the leased premises; or

(b) pay a delay drilling penalty as follows:

(i) for the sixth year of the lease $1.25 per acre per year; and

(ii) for the remainder of the primary term of the lease an amount per acre per year as the board may in its discretion determine.

(2) Notice of that determination shall be given to the lessee, and if the lessee applies for a hearing thereon within 10 days after receipt of the notice, the determination shall become final only after such hearing has been held.

(3) This annual delay drilling penalty shall be paid each year in advance.

(4) If a well for oil and gas is commenced, the drilling of the well shall be prosecuted with due diligence and dispatch to such depth as is necessary to make a reasonable test for oil or gas.

History: En. Sec. 2, Ch. 161, L. 1955; amd. Sec. 1, Ch. 251, L. 1965; amd. Sec. 86, Ch. 428, L. 1973; R.C.M. 1947, 81-1702.2(part); amd. Sec. 9, Ch. 15, L. 1979.

77-3-425. Dry hole clause. If the first well drilled is a dry hole and if a second well is not commenced on the land covered by the lease before the next anniversary of the lease following the completion of the well, the lease may be terminated by the board unless the lessee, on or before such anniversary, resumes the payments of penalties in the amounts provided in 77-3-424. Upon the resumption of the payment of such delay drilling penalties and their continued payment, the lease continues in force during the primary term as though there had been no interruption in the delay drilling penalty payments.

History: En. Sec. 2, Ch. 161, L. 1955; amd. Sec. 1, Ch. 251, L. 1965; amd. Sec. 86, Ch. 428, L. 1973; R.C.M. 1947, 81-1702.2(part).

77-3-426. Lessee to prevent waste. Oil and gas leases issued under the provisions of this part shall all be subject to the conditions that the lessee in conducting his explorations and mining or drilling operations shall use all reasonable precautions to prevent waste of oil or gas developed in the land or the entrance of water through wells drilled by him to the oil or gas sands or oil or gas bearing strata to the destruction or injury of the oil or gas deposits. Violations of any of these conditions shall constitute grounds for the forfeiture of the lease after hearing had thereon before the board.

History: En. Sec. 1, Ch. 108, L. 1927; re-en. Sec. 1882.1, R.C.M. 1935; amd. Sec. 1, Ch. 90, L. 1943; amd. Sec. 1, Ch. 261, L. 1947; amd. Sec. 6, Ch. 184, L. 1961; R.C.M. 1947, 81-1701(part).

77-3-427. Provision for offset wells — compensatory royalties. (1) Oil and gas leases granted by the state shall contain suitable provisions imposing upon all lessees the obligation to drill offset wells wherever and whenever necessary to prevent waste and damage to the property of the state.

(2) The board may allow the lessee the option of paying a compensatory royalty on a nonproducing lease in lieu of drilling an offset well if it determines that such compensatory royalty will fully compensate the state for waste and damage to the property of the state. The compensatory royalty shall be based upon the estimated drainage, as determined by the board, and shall be paid on a monthly basis unless circumstances require otherwise.

History: En. Sec. 19, Ch. 108, L. 1927; re-en. Sec. 1882.19, R.C.M. 1935; R.C.M. 1947, 81-1719(part); amd. Sec. 1, Ch. 81, L. 1981.

Compiler's Comments

1981 Amendment: Added subsection (2) relating to option of allowing compensatory royalties.

77-3-428. Additional development following completion of productive well. (1) The lessee shall be required, upon completing a commercially productive oil or gas well upon the leased premises, to proceed with reasonable diligence to drill such additional wells to the depth of the formation found commercially productive or to such depth as may be necessary to economically test, develop, and operate the deposits discovered.

(2) No lessee shall, however, be required to drill to completion more than one well under any one lease during any one calendar year or a total number of wells under any one lease in excess of the total number of 40-acre subdivisions of land held under such lease. As to lands found valuable for gas production only, the drilling obligation of the lessee shall be confined to a total number of wells equal to the total number of tracts comprising 160 acres of land included in the lease, except as the drilling of offset oil or gas wells necessary to protect the leased premises and deposits from loss or depletion due to wells drilled on contiguous lands shall require greater diligence in drilling and a greater number of wells to be drilled.

(3) The performance of said well drilling operations may be suspended only by and with the consent of the board during the time oil or gas previously discovered cannot be marketed at a profit or for other good cause shown.

History: En. Sec. 11, Ch. 108, L. 1927; re-en. Sec. 1882.11, R.C.M. 1935; R.C.M. 1947, 81-1711.

77-3-429. Operating agreements. Owners of state oil and gas leases may enter into agreements with other persons, associations, firms, and corporations for drilling and other operations on the state lands under their leases. No such operating agreements are in any way binding upon the state until filed with the board and approved by it. No such drilling or operating agreement in any way affects the obligations of each individual leaseholder to the state.

History: En. Sec. 2, Ch. 108, L. 1927; amd. Sec. 1, Ch. 193, L. 1931; amd. Sec. 1, Ch. 171, L. 1933; re-en. Sec. 1882.2, R.C.M. 1935; amd. Sec. 1, Ch. 109, L. 1941; amd. Sec. 1, Ch. 91, L. 1943; amd. Sec. 1, Ch. 128, L. 1945; amd. Sec. 1, Ch. 122, L. 1953; amd. Sec. 84, Ch. 428, L. 1973; R.C.M. 1947, 81-1702(3).

77-3-430. Pooling agreements and unit operations. Nothing contained in this or in prior related laws prevents the board from entering into agreements for the pooling of acreage with others for unit operations for the production of oil or gas or both and the apportionment of oil or gas royalties or both on an acreage or other equitable basis and from modifying leases with respect to delay rentals, delay drilling penalties, and royalties in accordance with such pooling agreements and such unit plans of operation. However, such agreements may not change the percentage of royalties to be paid to the state from the percentages as fixed in its leases. The board may modify existing pooling and unit agreements so as to commit the state lands included therein for as long as the unitized substance or substances for which the state lands are committed is produced from any lands in the unit.

History: En. Sec. 2, Ch. 108, L. 1927; amd. Sec. 1, Ch. 193, L. 1931; amd. Sec. 1, Ch. 171, L. 1933; re-en. Sec. 1882.2, R.C.M. 1935; amd. Sec. 1, Ch. 109, L. 1941; amd. Sec. 1, Ch. 91, L. 1943; amd. Sec. 1, Ch. 128, L. 1945; amd. Sec. 1, Ch. 122, L. 1953; amd. Sec. 84, Ch. 428, L. 1973; R.C.M. 1947, 81-1702(4).

77-3-431. Report of lessees. (1) On or before the last day of each month every holder of a producing oil or gas lease shall make a report to the department for the preceding calendar month on a form the department prescribes. The report shall show the amount of oil or gas produced and saved during the preceding month, the price obtained, the total amount of all sales, and any additional information as may be required, and it shall be signed by the lessee or some responsible person having knowledge thereof.

(2) Oil and gas leases granted by the state shall contain suitable provisions imposing upon all lessees the obligation to make such report of operation, production, and sales in the manner, at the time, and to such representative of the state as may be required by the board.

History: (1)En. Sec. 5, Ch. 108, L. 1927; re-en. Sec. 1882.5, R.C.M. 1935; amd. Sec. 2, Ch. 122, L. 1953; amd. Sec. 1, Ch. 171, L. 1963; amd. Sec. 87, Ch. 428, L. 1973; Sec. 81-1705, R.C.M. 1947; (2)En. Sec. 19, Ch. 108, L. 1927; re-en. Sec. 1882.19, R.C.M. 1935; Sec. 81-1719, R.C.M. 1947; R.C.M. 1947, 81-1705(part), 81-1719(part).

77-3-432. Royalty. In every oil and gas lease granted by the state under this part and acts amendatory thereto, there shall be reserved to the state as consideration therefor, in addition to the rentals as hereinbefore provided, a royalty in all oil and gas produced and saved from all lands covered thereby and not used for light, fuel, and operation purposes on the leased premises, which shall be equivalent to the full market value, as ascertained by the board at the date of such lease, of the estate or interest of the state in the lands and oil and gas deposits disposed of under such lease. Such royalty reservation shall be set by the board but may not be less than 12 ½% on gas and not less than 12 ½% on that portion of the average production of oil or casinghead gasoline for each producing well not exceeding 3,000 barrels for the calendar month.

History: En. Sec. 4, Ch. 108, L. 1927; re-en. Sec. 1882.4, R.C.M. 1935; amd. Sec. 1, Ch. 61, L. 1951; amd. Sec. 1, Ch. 103, L. 1965; amd. Sec. 2, Ch. 379, L. 1975; R.C.M. 1947, 81-1704(part).

77-3-433. Shut-in gas royalty. The royalty on gas, including casinghead gas and all gaseous substances, while the same is not sold or used off the premises, shall be at the rate of $400 per well each year or the amount of the annual rental provided in said lease in lieu of such per well rate, whichever is the greater, payable on or before the annual anniversary date of the lease. As long as such leased lands contain a well capable of such production and such payment is made, the lease shall be considered as a producing lease under the lease terms.

History: En. Sec. 4, Ch. 108, L. 1927; re-en. Sec. 1882.4, R.C.M. 1935; amd. Sec. 1, Ch. 61, L. 1951; amd. Sec. 1, Ch. 103, L. 1965; amd. Sec. 2, Ch. 379, L. 1975; R.C.M. 1947, 81-1704(part).

77-3-434. Manner of making royalty payment. Such lease shall provide for the rendering of payment of such royalty on all oil and gas produced and saved and sold or used off the premises in the following manner and upon the following terms:

(1) the lessee shall pay to the state in cash, for all oil and gas royalty reserved, the posted field price existing on the day such oil or gas is run into any pipeline or storage tank to the credit of the lessee, plus any bonus actually paid or agreed to be paid to the lessee for such oil or gas; or

(2) at the option of the state exercised in writing by the board not oftener than every 30 days, the lessee shall deliver the state's royalty oil or gas free

cost or deductions into the pipeline to which the wells of the lessee may be connected or into any storage designated by the state and connected with such wells.

History: En. Sec. 4, Ch. 108, L. 1927; re-en. Sec. 1882.4, R.C.M. 1935; amd. Sec. 1, Ch. 61, L. 1951; amd. Sec. 1, Ch. 103, L. 1965; amd. Sec. 2, Ch. 379, L. 1975; R.C.M. 1947, 81-1704(part).

77-3-435. Payments due to state. (1) The report under 77-3-431 shall be accompanied by payment of the amount due the state as royalty for the month covered by the report unless the state's royalty is being or has been paid direct by the purchaser thereof. However, where the amount of royalty due from any lease is determined by the board to be so small as to make it uneconomical to collect monthly, the board may authorize royalty payments to be made semiannually.

(2) Oil and gas leases granted by the state shall contain suitable provisions imposing upon all lessees the obligation to make payments due the state in the manner, at the time, and to such representative of the state as may be required by the board.

History: (1)En. Sec. 5, Ch. 108, L. 1927; re-en. Sec. 1882.5, R.C.M. 1935; amd. Sec. 2, Ch. 122, L. 1953; amd. Sec. 1, Ch. 171, L. 1963; amd. Sec. 87, Ch. 428, L. 1973; Sec. 81-1705, R.C.M.; (2)En. Sec. 19, Ch. 108, L. 1927; re-en. Sec. 1882.19, R.C.M. 1935; Sec. 81-1719, R.C.M. 1947; R.C.M. 1947, 81-1705(part), 81-1719(part).

77-3-436. Disposition of royalties and other money. All fees, rentals, penalties, royalties, and bonuses collected for or under state oil and gas leases shall be paid to the department and credited as follows:

(1) All fees and penalties shall be credited to the state general fund.

(2) All rentals shall be credited to the income fund of the grant to which the lands under each lease belong.

(3) All moneys collected as royalties and bonuses shall be credited to the permanent fund arising from the grant to which the land under each particular lease belongs and become and forever remain an inseparable and inviolable part thereof. However, all royalties and bonuses collected from the lands forming part of the capitol building grant shall be available as income, the same as all other receipts from such lands.

(4) All moneys received as rentals, royalties, and bonuses for or under leases on state lands and not held in trust for the public schools of the state or for any state institution shall be credited one-half to the state general fund and one-half to the state permanent revenue fund.

History: En. Sec. 12, Ch. 108, L. 1927; re-en. Sec. 1882.12, R.C.M. 1935; amd. Sec. 44, Ch. 100, L. 1973; amd. Sec. 89, Ch. 428, L. 1973; R.C.M. 1947, 81-1712.

77-3-437. Amendment of existing leases. The owner or owners of any existing state oil and gas lease shall have the right to exchange it for an amended lease containing the same provisions as to the term of said lease as are then provided by law for state oil and gas leases upon filing a written application therefor and upon payment of a sum which is the full market value of the exchange, as determined by the board. The amended lease shall be subject to all other provisions, including rents and royalties, contained in the original lease and shall bear the same commencement date as the original lease.

History: En. Sec. 8, Ch. 108, L. 1927; re-en. Sec. 1882.8, R.C.M. 1935; amd. Sec. 3, Ch. 122, L. 1953; R.C.M. 1947, 81-1708.

77-3-438. Assignments of leases. (1) The assignment of any oil and gas lease issued under this part, either in whole or as to subdivisions of land embracing not less than 40 acres covered thereby, made to an assignee qualified as provided herein is permitted. Such assignment is not, however, binding upon the state until filed with the department and accompanied by the required fees, together with such proof of qualifications required by the board, and approved by the board or its lawful representative. The approval of any assignment so filed and supported may not be withheld in any case where the rights or interest of the state in the property assigned will not in the judgment of the board be prejudiced thereby, and the decision of the board in all cases is subject to appeal upon proper court proceedings.

(2) All other assignments of oil and gas leases issued under this part or interests therein are subject to approval by the board and are binding upon the state in the discretion of the board.

History: En. Sec. 16, Ch. 108, L. 1927; re-en. Sec. 1882.16, R.C.M. 1935; amd. Sec. 90, Ch. 428, L. 1973; R.C.M. 1947, 81-1716.

77-3-439. Surrender of leases. The lessee under any oil and gas lease granted by the state may at the termination of any rental year, by giving to the department 30 days' previous notice in writing, surrender and relinquish the lease to the state in whole or as to any legal subdivision of the lands covered thereby and be discharged from any obligation not yet accrued as to lands so surrendered and relinquished without prejudice to the continuance of the lease as to lands not surrendered or relinquished.

History: En. Sec. 18, Ch. 108, L. 1927; re-en. Sec. 1882.18, R.C.M. 1935; amd. Sec. 92, Ch. 428, L. 1973; R.C.M. 1947, 81-1718.

77-3-440. Forfeiture and cancellation of leases. (1) All oil and gas leases granted by the state pursuant to the terms of this part shall provide for forfeiture and cancellation thereof upon failure of the lessee to fully discharge the obligations provided therein, after written notice from the state and reasonable time allowed to the lessee for performance of any undertaking or obligation specified in such notice concerning which the lessee is in default.

(2) Any lessee, upon application therefor, shall be granted a hearing on any notice or demand of the board before any lease is declared forfeited or canceled by the board.

History: En. Sec. 10, Ch. 108, L. 1927; re-en. Sec. 1882.10, R.C.M. 1935; R.C.M. 1947, 81-1710(part).

77-3-441. Restriction on new lease following termination of old lease. In all cases where an oil and gas lease issued after March 3, 1955, is surrendered for cancellation before its expiration, relinquished to the state, or canceled through proceedings on the part of the state, no new lease on the lands under such lease may be issued within 30 days from the date of cancellation or relinquishing. This restriction does not apply, however, in cases of bona fide assignment.

History: En. Sec. 1, Ch. 161, L. 1955; amd. Sec. 12, Ch. 22, L. 1971; amd. Sec. 85, Ch. 428, L. 1973; amd. Sec. 1, Ch. 136, L. 1974; amd. Sec. 1, Ch. 379, L. 1975; R.C.M. 1947, 81-1702.1(4).

77-3-443. Reservation in lease for disposition of surface. In every oil and gas lease granted pursuant to the terms hereof there shall be reserved unto the state the right to sell, lease, or otherwise dispose of the surface of the lands covered thereby, subject always to the rights and privileges granted unto the lessee under such oil and gas lease.

History: En. Sec. 1, Ch. 108, L. 1927; re-en. Sec. 1882.1, R.C.M. 1935; amd. Sec. 1, Ch. 90, L. 1943; amd. Sec. 1, Ch. 261, L. 1947; amd. Sec. 6, Ch. 184, L. 1961; R.C.M. 1947, 81-1701(part).

APPENDIX B: DEPARTMENT OF STATE LANDS LEASE DATA

DEFINITIONS OF VARIABLES

Column	Title	Definition and source
A	YEAR	
B	DD PENS	Delay drilling penalties assessed by the Department for failure to drill. Assessed in years 6 through 10. Source: DSL.
C	OLD RENT	Rent paid on leases one or more years old. Equal to oil and gas lease rental income from DSL biennial reports, less the consideration Computation by the Meadowlark Group.
D	CONSID	Consideration. The amount bid to obtain a state lease at the quarterly public lease auction. It includes the $1.50 per acre first years lease rental as well as the additional "bonus bid." Source: DSL.
E	INCOME	The annual lease revenue which accrues to the public school interest and income fund. It is the sum of delay drilling penalties, old rent, and the consideration paid for new leases. Data Source: DSL. Computation by the Meadowlark Group.
F	TOT ACRE	Total state acres leased for oil and gas as of June 30 of the year in Column A. Source: DSL.
G	NEW AC	New acres leased this year. Source: DSL.
H	TOT LEAS	Total number of state leases as of June 30 of the year in Column A. Source: DSL.
I	RENT/1.5	Total rental income divided by 1.5 (annual rental is $1.50 per acre). This is an approximation of the number of acres under lease in the subject year.
J	NEW LEAS	New state oil and gas leases entered into this year. Source: DSL.
K	RENT+BON	The sum of rentals plus bonus bids on all state leases for this year. Source: this value is from the column titled "Rentals on oil and gas leases," from the DSL Bienniel Reports. It is equal to the sum of old rent and the consideration.
L	NEW RENT	Rent on new acres leased this year. New rent equals the number of new acres (Col G) times 1.5 (annual rental).
M	BONUSES	The actual bonus, which is the total consideration bid less the first years rental of $1.50 per acre.
N	RENTALS	Total rentals. The sum of old rent and new rent.
O	PROD AC	Producing acres. The total number of acres on leased tracts which are producing oil and/or gas. Source: DSL.

P PROD LEAS Producing leases. The number of state leases which reported any production this year.

Q O PROD Oil production. The reported production of oil in barrels on state leases, for column n = 21 and 22. Source: DSL.
For n = 3,...,20, oil production has been estimated as follows:
Form: Qn = (8*Sn)/Rn, where n = 18,19,20.
Form: Qn = ((8*Wn)*(1-APn))/Rn, where n = 3,...,17.

R O PRICE Oil Price. This is an average reported field price for oil production in the state of Montana for this year. The values were derived by taking annual weighted average prices reported for tax purposes to the Montana Department of Revenue, which are on a calendar year basis, and averaging two years to obtain a fiscal year average, which is the timeline for state leases. This value is, then, a moving average of the two years' values for each year reported. Data source: Montana Department of Revenue. Computations by the Meadowlark Group.

S O ROYAL Oil royalties. Royalties paid to the State as the state's fair market value share of production. Source: DSL.

T GAS PROD Gas production. Production of natural gas in MCF on state leases this year. Source: DSL for n = 21 and 22, actual reported production.
For n = 3,...,20, gas production was estimated as follows:
Form: Tn = (8*Vn)/Un, where n = 18,19,20.
Form: Tn = (8*Wn*APn)/Un, where n = 3,...,17.

U G PRICE Gas price. Same source as oil price, Column R, above. Expressed as dollars per MCF.

V G ROYAL Gas royalties. Royalties paid to the state as the state's fair market value share of production. Source: DSL.

W ALL ROYAL All royalties. The sum of oil and gas royalties paid on production on state leases in this year. Source: DSL.

X DD ACRES DD PENS / 1.25. This column is a measure of the number of acres which are paying delay drilling penalties of $1.25 per acre. These acreages are all covered by leases which are at least six years old.

Form Xn = Bn / 1.25

Y OP INDEX Oil price index, 1960 = 1.00. An index of the reported field price of crude oil (Column R), with each value divided by the value in the initial year, which was 1960. The 1960 field price for crude oil was $2.47 per barrel.

Form Yn = Rn / 2.47,
where R1960 = 2.47.

Z GP INDEX Gas price index, 1960 = 1.00. Similar to OP INDEX, above.

Form Zn = Un / 6.4,
where U1960 = 6.4 cents per MCF.

AA O/G INDEX Oil / Gas relative price index. This is the ratio of the two preceding price indexes.

Form AAn = Yn / Zn.

AB AVG BONUS Average bonus per acre.

Form ABn = Mn / Gn

AC AVGCONSID Average Consideration per acre. Recall that consideration (variable D) was defined as bonus plus first year's rent on new leases.

Form ACn = Dn / Gn

AD DROP ACRE Acres dropped in the biennium ending this year.

Form ADn = Fn-2 + Gn-1 + Gn - Fn

¶	A	¶¶	B	¶¶	C	¶¶	D	¶¶	E	¶¶	F	¶¶	G	¶¶	H	¶¶	I	¶¶	J	¶¶	K	¶¶	L	¶
1¶	YEAR		DD PENS		OLD RENT		CONSID		INCOME		TOT ACRE		NEW AC		TOT LEAS		RENT/RATE		NEW LEAS		RENT+BON		NEW RENT	
2¶		1960	236729						859474		475638				1161						622745			
3¶		1961	219870		340228		320692		880790				159449				659126		388		660920		159449	
4¶		1962	200953		325671		346203		872827		491945		145343		1164		616357		320		671874		145343	
5¶		1963	191827		358060		525839		1075726				149121				656302		325		883899		149121	
6¶		1964	198139		316268		457246		971653		614557		253288		1404		822844		607		773514		253288	
7¶		1965	231455		444294		420255		1096004				168527				781348		384		864549		168527	
8¶		1966	249982		433183		336378		1019543		617927		174754		1480		782691		409		769561		174754	
9¶		1967	184567		328190		430117		942874				181620				691430		396		758307		181620	
10¶		1968	146510		175142		5288418		5610070		736982		736982		1455		1649106		1455		5463560		736982	
11¶		1969	130010		1093983		1335314		2559307				529610				2153203		1310		2429297		529610	
12¶		1970	104484		1396843		573980		2075307		1461854		260368		3185		1917579		622		1970823		260368	
13¶		1971	96174		1016596		297780		1410550				179264				1375124		428		1314376		179264	
14¶		1972	170389		860399		771648		1802436		1403653		467691		3205		1795781		1028		1632047		467691	
15¶		1973	238380		1069418		1265457		2573255				560073				2189564		1154		2334875		560073	
16¶		1974	449431		1330063		1408988		3188482		1897965		538497		4227		2407057		1216		2739051		538497	
17¶		1975	533927		1927108		874432		3335467				276315				2479738		646		2801540		276315	
18¶		1976	538868		1829727		749424		3118019		2131625		369650		4687		1959118		591		2579151		554475	
19¶		1977	525823		1170538		1922694		3619055				361636				1503631.		823		3093232		542454	
20¶		1978	924885		3169697		4356693		8451275		2630787		586448		6080		3286027.		1406		7526390		879672	
21¶		1979	1141819		2820712		3993384		7955915				418544				2717563.		959		6814096		627816	
22¶		1980	1249098		3497427		24398191		29144716		3636882		947952		8269		4227522		2088		27895618		1421928	
23¶		1981	1414656		4661243		17616476		23692375		4628813		1128639		10522		5364773.		2561		22277719		1692959.	

¶	M	¶¶	N	¶¶	O	¶¶	P	¶¶	Q	¶¶	R	¶¶	S	¶¶	T	¶¶	U	¶¶	V	¶¶	W	¶
1¶	BONUSES		RENTALS		PROD AC		PROD	LEASO	PROD		O PRICE		O ROYAL		GAS PROD	G	PRICE	G	ROYAL		ALL ROYAL	
2¶											2.47						.064				617016	
3¶	161243		659126						1380637		2.43				2788173		.066				442371	
4¶	200860		616357						1281061		2.41				2240313		.062				403282	
5¶	376718		656302						1227856		2.44				2082405		.063				390895	
6¶	203958		822844						1332581		2.44				2129795		.066				424008	
7¶	251728		781348						1349849		2.44				2217123		.065				429718	
8¶	161624		782691		49306				1782361		2.44				2997905		.073				570976	
9¶	248497		691430						1635857		2.47				2674112		.08				531812	
10¶	4551436		1649106						1482875		2.53				1909535		.0835				488890	
11¶	805704		2153203						1952350		2.66				3338971		.08				682546	
12¶	313612		1917579		54343		175		1532544		2.79				2788948		.0765				561144	
13¶	118516		1375124						1492080		2.94				2944753		.0815				578339	
14¶	303957		1795781		50287		150		1480875		3.02				2763830		.091				590469	
15¶	705384		2189564						1629940		3.42				4492816		.1295				769527	
16¶	870491		2407057		65213		187		1763217		5.33				4281922		.2055				1284735	
17¶	598117		2479738						1674533		7.32				3696288		.323				1681435	
18¶	194949		2938677		76477		195		1845702		8.16		1882616		3744384		.417		195176		2077792	
19¶	1380240		2255446						1928314		8.78		2116325		3400028		.58		246502		2362827	
20¶	3477021		4929041		103576		270		1663967		9.19		2586423		3769423		.76		395237		2981660	
21¶	3365568		4076344						1602019		11.52		2355418		3919025		1.02		527551		2882969	
22¶	22976263		6341283		122435		294		1700489		20.67		3637689		3624719		1.18		639307		4276996	
23¶	15923518		8047160				325						8161878						1278576		9440454	

¶	X ¶¶	Y ¶¶	Z ¶¶	AA ¶¶	AB ¶¶	AC ¶¶	AD ¶
1¶	DD ACRES	OP INDEX	GP INDEX	O/G INDEX	AVG BONUS	AVG CONSID	DROP ACRE
2¶	189383	1	1	1			
3¶	175896	.9838057	1.03125	.9539934	1.011251	2.011251	
4¶	160762	.9757085	.96875	1.007183	1.381972	2.381972	288485
5¶	153462	.9878543	.984375	1.003534	2.526257	3.526257	
6¶	158511	.9878543	1.03125	.9579193	.8052415	1.805241	279797
7¶	185164	.9878543	1.015625	.9726565	1.493695	2.493695	
8¶	199986	.9878543	1.140625	.8660640	.9248658	1.924866	339911
9¶	147654	1	1.25	.8	1.368225	2.368225	
10¶	117208	1.024291	1.304688	.7850857	6.175776	7.175776	799547
11¶	104008	1.076923	1.25	.8615385	1.521316	2.521316	
12¶	83587	1.129555	1.195313	.9449869	1.204495	2.204495	65106
13¶	76939	1.190283	1.273438	.9347011	.6611255	1.661125	
14¶	136311	1.222672	1.421875	.8599012	.6499099	1.649910	705156
15¶	190704	1.384615	2.023438	.6842887	1.259450	2.259450	
16¶	359545	2.157895	3.210938	.6720451	1.616520	2.616520	604258
17¶	427142	2.963563	5.046875	.5872075	2.164620	3.164620	
18¶	431094	3.303644	6.515625	.5070340	.5273881	2.027388	412305
19¶	420658	3.554656	9.0625	.3922379	3.816655	5.316655	
20¶	739908	3.720648	11.875	.3133177	5.928950	7.428950	448922
21¶	913455	4.663968	15.9375	.2926411	8.041133	9.541133	
22¶	999278	8.368421	18.4375	.4538805	24.23779	25.73779	360401
23¶	1131725				14.10860	15.60860	

APPENDIX C: STATEWIDE OIL INDUSTRY DATA

DEFINITIONS OF VARIABLES IN ANALYSIS

Column Title Definition and source

A YEAR

B OIL PROD Oil production. Total annual statewide oil production on all lands, in barrels. Source: Annual Reports of the Montana Board of Oil and Gas Conservation, various years.

C PRODWELLS Producing wells. Total number of producing oil wells in the state of Montana on all lands. Source: Annual Reports of the montana Board of Oil and Gas Conservation, various years.

D PROD/WELL Average daily production per oil well. Statewide daily oil production average. Source: BOGC Annual Reports.

E DWD OIL Developmental wells drilled, oil. Total number of developmental wells drilled, which produced oil. Source: BOGC Annual Reports.

F DWD GAS Developmental wells drilled, gas. Statewide developmental wells drilled, which produced gas. Source: BOGC Annual Reports.

G DWD DRY Developmental wells drilled, dry holes. Statewide developmental wells drilled, which did not produce. Source: BOGC Annual Reports.

H EWD OIL Exploratory wells drilled, oil. Of the exploratory wells drilled this year, those which produced oil. Source: BOGC Annual Reports.

I EWD GAS Exploratory wells drilled, gas. Of those exploratory wells drilled this year, those which produced gas. Source: BOGC Annual Reports.

J EWD DRY Exploratory wells drilled, dry holes. Of those exploratory wells drilled this year, those that were dry holes. Source: BOGC Annual Reports.

K TOT WD Total wells drilled. The total of all oil and gas wells drilled within the entire state of Montana this calendar year. Source: BOGC Annul Reports.

L TOT FOOTD Total footage drilled. Total drilled footage in the entire state of Montana in all oil and gas wells. Source: BOGC Annual Reports.

M AVG DEPTH Average depth. Average depth of all oil and gas wells drilled in the entire state of Montana this year. Source: BOGC Annual Reports.

N GAS PROD Gas production. Production of natural gas in MCF from all

wells in the state of Montana this year. Source: BOGC Annual Reports.

0 PRODWELLS Producing gas wells. Total number of producing natural gas wells in the state of Montana this year. Source: BOGC Annual Reports.

	A	B	C	D	E	F	G
1	YEAR	OIL PROD	PRODWELLS	PROD/WELL	DWD OIL	DWD GAS	DWD DRY
2							
3	1961	30906044	3387	25	169	6	60
4	1962	31647507	3692	23.5	182	16	57
5	1963	30869653	3642	23.2	131	6	60
6	1964	30647498	3329	25.2	100	7	109
7	1965	32778118	3810	23.6	177	9	107
8	1966	35380118	3507	27.6	179	9	96
9	1967	34959026	3390	28.2	162	14	104
10	1968	48460246	3391	39	300	14	89
11	1969	43954112	3335	36.1	171	44	105
12	1970	37878697	3212	32.3	60	30	63
13	1971	34598723	3145	30.1	49	36	34
14	1972	33904139	3134	29.6	79	97	87
15	1973	34620182	2993	31.7	46	165	100
16	1974	34553962	3100	30.5	58	179	212
17	1975	32843674	3435	26.2	105	261	222
18	1976	32814260	3309	27.1	106	264	169
19	1977	32680054	3418	26.2	98	220	188
20	1978	30467337	3546	23.5	123	223	232
21	1979	29957099	3592	22.9	120	235	182
22	1980	29583804	3838	21.1	241	203	206

	H	I	J	K	L	M	N	O
1	EWD OIL	EWD GAS	EWD DRY	TOT WD	TOT FOOTD	AVG DEPTH	GAS PROD	PRODWELLS
2							35381	
3	7	2	173	417	2209803	5299	34884	
4	8	2	154	419	2415856	5765	28973	
5	8	5	152	362	1906976	5268	27113	
6	22	3	150	391	1863155	4765	25234	
7	14	1	199	507	2328865	4593	27873	
8	10	3	185	482	2211369	4588	32414	784
9	7	5	191	483	2158964	4470	31619	648
10	15	13	509	940	4547691	4839	31917	1196
11	15	5	466	806	3682758	4569	41229	1098
12	12	11	272	448	1969583	4396	37445	739
13	3	22	323	467	1735222	3716	38137	1056
14	7	19	435	724	2300075	3177	35606	1116
15	6	36	366	719	1834288	2551	58896	1118
16	7	21	265	742	2173519	2929	51401	1450
17	6	15	236	845	2467838	2921	44546	1235
18	17	8	223	787	2826301	3591	45098	1490
19	24	19	129	678	2482379	3661	48181	1438
20	21	15	179	793	2968842	3744	47140	1755
21	35	20	211	803	3147341	3919	53888	
22	30	12	260	952	4032032	4235	53802	

APPENDIX D: LEASING POLICY COMPARISONS

LEASING POLICY SUMMARY

STATE: Montana

ADMINISTERED BY:

Montana Department of State Lands
1625 Eleventh Avenue
Helena, Montana 59620
Telephone 406-449-2074

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 0-3000 Bbl/month, 12 1/2%; 3000-6000 Bbl/m, 17 1/2%; Over 6000 Bbl/m, 25%.

Gas: 12 1/2%

Annual rental rate: $1.50 per acre.

Rent paid during production: Yes.

Lease duration: ten years.

Delay drilling penalty: $1.25 per acre, years six through ten.

Lease Acquisition Method: Auction.

Auction Method: Oral Auction.

Computerized Royalty Management: No, but have future Plans.

LEASING POLICY SUMMARY

ENTITY: United States of America

ADMINISTERED BY:

Bureau of Land Management
U.S. Department of the Interior
P.O. Box 30157
Billings, MT 59107
Telephone 406-657-6291

OIL AND GAS LEASING TERMS

	Non-competitive	Competitive Bidding
Royalty rate.		
Oil:	12 1/2%	12 1/2% - 25%, based on production
Gas:	12 1/2%	12 1/2% - 16 2/3%, based on production
Annual rental:	$1.00/acre, years 1-5 $3.00/acre, years 6-10, until production starts.	$2.00/acre

Rent paid during production: No.

Lease duration: ten years.

Delay drilling penalty: Not called such, but the higher rental in years 6 through 10 is intended to serve the same purpose.

Lease Acquisition Method: Simultaneous filing for non-competitive leases. The filing fee was raised to $75, effective Feb. 19, 1982. Competitive bidding with sealed bids is used with the competitive leases. Some tracts are leased over the counter. (See comment below.)

Additional Comments: Lands whose previous leases have terminated for any reason are listed in the simultaneous filing process. Commonly called the lottery, any American can pay the filing fee and have a chance to acquire this lease. Lands in a known geological structure (KGS) are leased through competitive bids. Lands never leased before, or not taken in simultaneous filings can be leased over the counter.

LEASING POLICY SUMMARY

ENTITY: Indian Lands in Montana

ADMINISTERED BY:

Bureau of Indian Affairs
Real property Management
316 N. 26th
Billings, MT 59101
Telephone 406-657-6301

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 16 2/3% (see comment below)

Gas: 16 2/3% (see comment below)

Annual rental rate: $1.25/acre (see comment below)

Rent paid during production: Yes.

Lease duration: five years. (see comment below)

Delay drilling penalty: No.

Lease Acquisition Method: Publicly advertised sealed bid auction to select lessee. Following lessee selection, Tribal authorities negotiate additional terms and conditions of the lease.

Additional Comments: The U.S. Code of Federal Regulations requires that lease sales on tribal lands be advertised and that the prospective lessee be selected on the basis of the sealed bonus bid. Once the lessee has been selected by this manner, however, the tribal authorities have the option to enter into negotiations with the prospective lessee for additional terms which would benefit or protect tribal interests. This has included royalty rates in the 20 to 25% range, annual rentals in the $3.50 to $5.00 range, and stiffer environmental stipulations.

LEASING POLICY SUMMARY

STATE: California

ADMINISTERED BY:

State Lands Commission
100 Oceangate - Suite 300
Long Beach, California 90802
Telephone 213-590-5201

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 16 2/3% minimum

Gas: 16 2/3% minimum

Annual rental rate: $1.00/acre

Rent paid during production: Yes.

Lease duration: three years. May be extended or terminated at that time.

Delay drilling penalty: No.

Lease Acquisition Method: Auction.

Auction Method: Sealed Bid. May be based on one of the following: Cash bonus plus a sliding scale royalty; sliding scale royalty multiplier; flat rate royalty; or net profits bonus.

Computerized Royalty Management: Yes.

Additional Comments: Awards are not made at the time of bid opening, but rather are made following a technical review by Commission staff and a legal review by the Office of the Attorney General.

LEASING POLICY SUMMARY

STATE: Colorado

ADMINISTERED BY:

Board of Land Commissioners
1313 Sherman St.
Denver, Colorado 80203
Telephone 303-866-3454

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 12 1/2%

Gas: 12 1/2%

Annual rental rate: $1.00 per acre per year for the first five years, and $2.00 per acre per year for the second five years.

Rent paid during production: Yes.

Lease duration: ten years.

Delay drilling penalty: Not as such, but the higher rentals in years six through ten have the same effect.

Lease Acquisition Method: Auction.

Auction Method: Oral Auction.

Computerized Royalty Management: No.

Additional Comments: Lease duration is considered two term, with the second five year term being automatically granted upon payment of the sixth year's lease. The change to the two-term system, including the higher rate in years six through ten, was made in 1981. The effects will not be known until 1985, when those leases begin to approach the sixth year.

LEASING POLICY SUMMARY

STATE: Idaho

ADMINISTERED BY:

Department of Lands
Statehouse
Boise, ID 83720
Telephone 208-334-3280

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 12 1/2%

Gas: 12 1/2%

Annual rental rate: $1.00 per acre

Rent paid during production: No.

Lease duration: ten years.

Delay drilling penalty: $1.00 per acre diligent exploration penalty in years six through ten.

Lease Acquisition Method: Auction.

Auction Method: Oral Auction.

Computerized Royalty Management: No. Have future plans.

Additional Comments: There is no oil or gas production in the state of Idaho. In the last three years there were only three wells drilled on state tracts and all were dry holes.

LEASING POLICY SUMMARY

STATE: New Mexico

ADMINISTERED BY:

New Mexico State Land Office
P.O. Box 1148
Santa Fe, New Mexico 87501
Telephone 505-827-5378

OIL AND GAS LEASING TERMS

	KGS	Other (see comment)
Royalty rate.		
Oil:	16 2/3%	12 1/2%
Gas:	16 2/3%	12 1/2%
Annual rental rate:	$1.00/acre	$0.10-0.25/acre

Rent paid during production: Yes.

Lease duration: five years ten years

Delay drilling penalty: Rent doubles in years 6-10 if not drilled.

Lease Acquisition Method: Auction.

Auction Method: Sealed Bid, or if no sealed bids, oral auction.

Computerized Royalty Management: Yes.

Additional Comments: State Lands in New Mexico are classified. KGS stands for known geological structure. The other lands include: out of productive area; non-productive area; and non-restricted area.

LEASING POLICY SUMMARY

STATE: North Dakota

ADMINISTERED BY:

State Land Department
Sixth Floor State Capitol
Bismarck, North Dakota 58505
Telephone 701-224-2803

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 16 2/3%

Gas: 16 2/3%

Annual rental rate: $1.00 per acre per year.

Rent paid during production: No.

Lease duration: five years.

Delay drilling penalty: A lease can be extended 180 days for a fee of $10.00 per acre, and can be extended an additional 180 days for an additional fee of $20.00 per acre. Total extension cannot exceed 360 days.

Lease Acquisition Method: Auction.

Auction Method: Oral Auction.

Computerized Royalty Management: Future Plans.

LEASING POLICY SUMMARY

STATE: Oklahoma

ADMINISTERED BY:

Land Office
Jim Thorpe Building
Oklahoma City, Oklahoma 73105
Telephone

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 18.75% (3/16)

Gas: 18.75%

Annual rental rate: $0.50 per acre.

Rent paid during production: No.

Lease duration: five years.

Delay drilling penalty: No.

Lease Acquisition Method: Auction.

Auction Method: Sealed Bid.

Computerized Royalty Management: Yes.

LEASING POLICY SUMMARY

STATE: South Dakota

ADMINISTERED BY:

Department of School and Public Lands
State Capitol Building
Pierre, South Dakota 57501
Telephone 605-773-3303

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 16 2/3%

Gas: 16 2/3%

Annual rental rate: $1.00 per acre per year.

Rent paid during production: No.

Lease duration: five years.

Delay drilling penalty: No.

Lease Acquisition Method: Auction.

Auction Method: Oral Auction.

Computerized Royalty Management: No.

LEASING POLICY SUMMARY

STATE: Texas

ADMINISTERED BY:

General Land Office
Austin, Texas 78701
Telephone 512-475-3064

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 25%

Gas: 25%

Annual rental rate: $5.00/acre, beginning in the second year.

Rent paid during production: No.

Lease duration: three years.

Delay drilling penalty: No.

Lease Acquisition Method: Auction.

Auction Method: Sealed Bid, with a minimum. Bonus bid includes first year's rent.

Computerized Royalty Management: Yes.

Additional Comments: For some land categories, notably submerged and offshore in the gulf, the applicants bid on royalty rates over the minimum of 25%.

LEASING POLICY SUMMARY

STATE: Utah

ADMINISTERED BY:

Division of State Lands
Department of Natural Resources
Room 411 Empire Building
231 East 400 South
Salt Lake City, UT 84111
Telephone 801-533-5381

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 16 2/3%

Gas: 16 2/3%

Annual rental rate: $1.00 per acre

Rent paid during production: Yes, but can deduct it on the last royalty report.

Lease duration: ten years.

Delay drilling penalty: No.

Lease Acquisition Method: Simultaneous list (auction)

Auction Method: Sealed Bid (minimum bid, $1.00/acre). Other tracts are over the counter.

Computerized Royalty Management: No, but have future plans.

Additional Comments: Royalty payments are made quarterly.

LEASING POLICY SUMMARY

STATE: Wyoming

ADMINISTERED BY:

Department of Public Lands and Farm Loans
State Capitol Building
Cheyenne, Wyoming
Telephone 307-777-7331

OIL AND GAS LEASING TERMS

Royalty rate.

Oil: 16 2/3%

Gas: 16 2/3%

Annual rental rate: $1.00 per acre per year.

Rent paid during production: Yes.

Lease duration: five years.

Delay drilling penalty: No.

Lease Acquisition Method: Simultaneous Filing.

Auction Method: Not Applicable.

Computerized Royalty Management: No.

Additional Comments: Recently increased royalty from 12 1/2%, and reduced duration of lease from ten years.

APPENDIX E: TAXATION COMPARISONS

In June of 1981 the California Assembly Office of Research published a report entitled "State Taxation on the Production of Crude Oil: A Comparison of Nine States." This document is the major reference for this overview of oil and gas taxation.

According to the California report, Montana ranks 13th among the states in terms of annual oil production, but ranks first (that is, imposes the highest tax burden) among the nine states studied.

The California report specified two hypothetical corporations, corporations A and B, and then calculated the tax burden of each for each of the nine states studied. The major features of Corporations A and B follow.

	Corporation A	Corporation B
Assets	$54,900,000	$8,267,000
Revenues from oil sales	25,600,000	10,321,000
Oil Reserves (barrels)	4,000,000	1,490,000
Annual oil production	800,000	322,500

The following two tables reflect the current tax liability of hypothetical corporations A and B for each of the nine states studied. Following these comparisons are two tables comparing the effective tax rates levied for Fiscal Years 1981 and 1982. In each of the following tables, states are ranked in the order of their level of taxation.

CURRENT TAX LIABILITY BY STATE
HYPOTHETICAL CORPORATION A

Rank**	State	Total State and Local Taxes	Percentage Relationship to California	Property Tax	Rank	State Income Tax	Rank	Sales Tax	Rank	Franchise Tax	Rank	Oil Severance Tax	Rank
1	Montana	$5,108,364	164.8	$3,458,000	(1)	$406,204	(4)	N/A	(9)	N/A	(6*)	$1,244,160	(7)
2	Alaska	4,069,722	131.3	800,000	(6)	713,122	(2)	$243,000	(2*)	N/A	(6*)	2,313,600	(3)
3	Louisiana	3,871,953	124.9	367,200	(9)	194,603	(7)	243,000	(2*)	$46,350	(2)	3,020,800	(1)
4	Wyoming	3,766,000	121.5	2,136,000	(2)	N/A	(8*)	194,400	(7)	2,000	(5)	1,433,600	(6)
5	North Dakota	3,717,976	120.0	442,740	(8)	331,356	(5)	145,800	(8)	N/A	(6*)	2,798,080	(2)
6	Texas	3,604,581	116.3	2,086,656	(3)	N/A	(8*)	243,000	(2*)	97,325	(1)	1,177,600	(8)
7	Oklahoma	3,209,244	103.6	900,000	(5)	232,484	(6)	243,000	(2*)	20,000	(3)	1,813,760	(5)
8	California	3,098,899	100.0	1,969,800	(4)	838,099	(1)	291,600	(1)	N/A	(6*)	N/A	(9)
9	New Mexico	3,046,605	98.3	547,607	(7)	414,958	(3)	230,850	(6)	12,595	(4)	1,840,640	(4)

* Tie
**Ranked by total state and local taxes.
N/A = not applicable

CURRENT TAX LIABILITY BY STATE
HYPOTHETICAL CORPORATION B

Rank**	State	Total State and Local Taxes	Percentage Relationship to California	Property Tax	Rank	State Income Tax	Rank	Sales Tax	Rank	Franchise Tax	Rank	Oil Severance Tax	Rank
1	Montana	$1,773,421	200.3	$1,183,901	(1)	$ 87,919	(5)	N/A	(9)	N/A	(6*)	$ 501,601	(7)
2	Louisiana	1,353,822	152.9	47,782	(9)	45,845	(7)	31,620	(2*)	$ 7,155	(2)	1,221,418	(1)
3	Alaska	1,304,436	147.3	104,100	(5)	177,950	(2)	$ 31,620	(2*)	N/A	(6*)	990,816	(3)
4	Texas	1,301,369	147.0	777,279	(2)	N/A	(8*)	31,620	(2*)	17,701	(1)	474,766	(8)
5	Wyoming	1,301,007	146.9	697,335	(3)	N/A	(8*)	25,296	(7)	400	(5)	577,976	(6)
6	North Dakota	1,294,505	146.2	57,612	(8)	89,836	(4)	18,972	(8)	N/A	(6*)	1,128,085	(2)
7	New Mexico	974,696	110.1	92,647	(7)	107,549	(3)	30,039	(6)	2,291	(3)	742,080	(4)
8	Oklahoma	945,838	106.8	117,112	(5)	64,032	(6)	31,620	(2*)	1,831	(4)	731,243	(5)
9	California	885,342	100.0	620,077	(4)	227,321	(1)	37,944	(1)	N/A	(6*)	N/A	(9)

* Tie
**Ranked by total state and local taxes.
N/A = non applicable

EFFECTIVE TAX RATES LEVIED ON THE PRODUCTION OF CRUDE OIL IN NINE OIL-PRODUCING STATES

(Fiscal Year 1980-81)

State	Volume of Oil Production (millions of barrels)	Gross Value of Production (millions)	Taxable Value of Production (millions)	Statutory Tax Rates (percent)	Total Revenue (millions)	Effective Tax Rates (percent)	Accumulated Tax Rate (percent)
Montana	25.2	$ 520.0	$ 506.0	2.65	$ 13.4	2.58	13.08
			(A.V.) 312.0	17.50	54.6	10.50	
Louisiana	200.0	5,293.0	5,293.0	12.50	624.6	11.80	11.80
Wyoming	33.9	1,895.0	1,895.0	4.00	68.2	3.60	10.10
			(A.V.) 1,895.0	6.50	123.2	6.50	
Alaska	589.0	8,680.0	6,840.0	12.25	837.0	9.60	9.60
Oklahoma	150.1	4,860.0	4,860.0	7.085	344.3	7.085	7.085
New Mexico	75.1	1,799.0	1,574.0	7.99	122.4	6.80	6.80
North Dakota	40.0	800.0	800.0	5.00	40.0	5.00	5.00
Texas[a]	876.0	27,323.0	27,323.0	4.60	1,257.0	4.60	4.60
California[b]	299.0	8,100.0	8,100.0	2.50	202.5	2.50	2.50

A.V. = Ad Valorem Production Tax; All other figures are for oil severance tax.

[a]Texas' local jurisdictions impose a property tax on oil reserves, but according to Texas state officials, it is equivalent to only a .02 percent oil severance tax.

[b]California imposes a property tax on oil reserves, but for purposes of this table we have converted it into an equivalent oil severance tax of 2.5 percent.

EFFECTIVE TAX RATES LEVIED ON THE PRODUCTION
OF CRUDE OIL IN NINE OIL-PRODUCING STATES

(Fiscal Year 1981-82)

State	Volume of Oil Production (millions of barrels)	Gross Value of Production (millions)	Taxable Value of Production (millions)	Statutory Tax Rates (percent)	Total Revenue (millions)	Effective Tax Rates (percent)	Accumulated Tax Rate (percent)
Montana	25.2	$ 776.9	$ 755.7	5.00	$ 37.8	4.86	15.36
			(A.V.) 466.1	17.50	81.6	10.50	
Louisiana	190.0	6,840.0	6,840.0	12.50	807.1	11.80	11.80
Wyoming	85.3	3,412.0	3,412.0	6.00	191.1	5.60	11.60
			(A.V.) 3,412.0	6.00	204.7	6.00	
North Dakota	45.0	2,025.0	2,025.0	6.50	120.0	5.93	10.93
				5.00	101.2	5.00	
Alaska	582.0	13,370.0	10,530.0	12.25	1,290.0	9.60	9.60
New Mexico	71.9	2,991.0	2,692.0	7.99	215.1	7.19	7.19
Oklahoma	150.6	6,323.0	6,323.0	7.085	448.0	7.085	7.085
Texas[a]	833.0	32,533.0	32,533.0	4.60	1,496.0	4.60	4.60
California[b]	302.0	8,700.0	8,700.0	2.50	217.5	2.50	2.50

A.V. = Ad Valorem Production Tax; All other figures are for oil severance tax.

[a]Texas' local jurisdictions impose a property tax on oil reserves, but according to Texas state officials, it is equivalent to only a .02 percent oil severance tax.

[b]California imposes a property tax on oil reserves, but for purposes of this table we have converted it into an equivalent oil severance tax of 2.5 percent.

APPENDIX F. ANALYSIS OF CURRENT POLICIES

MODADJ3 Current Policies. Average Bonus = 310; Constant Production.

Disk D-5 Discount Rate = 3.5%.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	YEAR	TOT ACRE	OLD ACRE REN	RATE	OLD RENT	DD ACRE	DD RATE	DD PENS	NEW ACRE	NEW RENT	AV BONUS	BONUSES	INCOME	OO PROD
2	1980	3636882	2688930	1.5	4033395	999278	1.25	1249098	947952	1421928	24.24	22976263	29144716	1700489
3	1981	4628813	3500174	1.5	5250261	1131725	1.25	1414656	1128639	1692959	14.11	15923518	23692375	
4	1982													
5	1983	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	2000000
6	1984	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	2000000
7	1985	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	2000000
8	1986	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	2000000
9	1987	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	2000000
10	1988	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	2000000
11	1989	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1900000
12	1990	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1800000
13	1991	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1700000
14	1992	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1600000
15	1993	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1500000
16	1994	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1400000
17	1995	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1300000
18	1996	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1200000
19	1997	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1100000
20	1998	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	1000000
21	1999	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	900000
22	2000	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	10	10000000	19500000	800000

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	O PRICE	OO VALUE	OOR RATE	OO ROYAL	NO PROD	NO VALUE	NOR RATE	NO ROYAL	TO ROYAL	OG PROD	G PRICE	OG VALUE	OGR RATE	OG ROYAL
2	20.67	35149100	.125	3637689		0			3637689	3624719	1.18	4277168.	.125	639307
3			.125	8161878		0			8161878				.125	1278576
4						0			0					
5	35	70000000	.125	8750000		0	.125	0	8750000	4000000	2.77	11080000	.125	1385000
6	35	70000000	.125	8750000		0	.125	0	8750000	4000000	2.77	11080000	.125	1385000
7	35	70000000	.125	8750000		0	.125	0	8750000	4000000	2.77	11080000	.125	1385000
8	35	70000000	.125	8750000		0	.125	0	8750000	4000000	2.77	11080000	.125	1385000
9	35	70000000	.125	8750000		0	.125	0	8750000	4000000	2.77	11080000	.125	1385000
10	35	70000000	.125	8750000		0	.125	0	8750000	4000000	2.77	11080000	.125	1385000
11	35	66500000	.125	8312500	100000	3500000	.125	437500	8750000	4000000	2.77	11080000	.125	1385000
12	35	63000000	.125	7875000	200000	7000000	.125	875000	8750000	4000000	2.77	11080000	.125	1385000
13	35	59500000	.125	7437500	300000	10500000	.125	1312500	8750000	4000000	2.77	11080000	.125	1385000
14	35	56000000	.125	7000000	400000	14000000	.125	1750000	8750000	4000000	2.77	11080000	.125	1385000
15	35	52500000	.125	6562500	500000	17500000	.125	2187500	8750000	4000000	2.77	11080000	.125	1385000
16	35	49000000	.125	6125000	600000	21000000	.125	2625000	8750000	4000000	2.77	11080000	.125	1385000
17	35	45500000	.125	5687500	700000	24500000	.125	3062500	8750000	4000000	2.77	11080000	.125	1385000
18	35	42000000	.125	5250000	800000	28000000	.125	3500000	8750000	4000000	2.77	11080000	.125	1385000
19	35	38500000	.125	4812500	900000	31500000	.125	3937500	8750000	4000000	2.77	11080000	.125	1385000
20	35	35000000	.125	4375000	1000000	35000000	.125	4375000	8750000	4000000	2.77	11080000	.125	1385000
21	35	31500000	.125	3937500	1100000	38500000	.125	4812500	8750000	4000000	2.77	11080000	.125	1385000
22	35	28000000	.125	3500000	1200000	42000000	.125	5250000	8750000	4000000	2.77	11080000	.125	1385000

	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
1	NG PROD	NG VALUE	NGR RATE	NG ROYAL	TG ROYAL	T ROYAL	TRUS INC	TRUS BAL	INT RATE	INTEREST	INT+INC	PV: I+I	PV:BONUS	PV:T ROYS
2		0		0	639307	4276996	5734232.							
3		0		0	1278576	9440454	10625073							
4		0		0	0	0								
5		0	.125	0	1385000	10135000	11110000	0	.02	0	18525000	2.6564e8	1.3199e8	1.3506e8
6		0	.125	0	1385000	10135000	11121110	11110000	.02	211090	18736090			
7		0	.125	0	1385000	10135000	11132231	22231110	.02	422391.1	18947391			
8		0	.125	0	1385000	10135000	11143363	33363341	.02	633903.5	19158903			
9		0	.125	0	1385000	10135000	11154507	44506704	.02	845627.4	19370627			
10		0	.125	0	1385000	10135000	11165661	55661211	.02	1057563.	19582563			
11	83000	229910	.125	28738.75	1413739.	10163739	11205566	66826872	.02	1269711.	19794711			
12	167000	462590	.125	57823.75	1442824.	10192824	11245856	78032438	.02	1482616.	20007616			
13	250000	692500	.125	86562.5	1471563.	10221563	11285841	89278294	.02	1696288.	20221288			
14	333000	922410	.125	115301.3	1500301.	10250301	11325865	1.0056e8	.02	1910719.	20435719			
15	417000	1155090	.125	144386.3	1529386.	10279386	11366276	1.1189e8	.02	2125910.	20650910			
16	500000	1385000	.125	173125	1558125	10308125	11406381	1.2326e8	.02	2341869.	20866869			
17	583000	1614910	.125	201863.8	1586864.	10336864	11446526	1.3466e8	.02	2558590.	21083590			
18	667000	1847590	.125	230948.8	1615949.	10365949	11487058	1.4611e8	.02	2776075.	21301075			
19	750000	2077500	.125	259687.5	1644688.	10394688	11527284	1.5760e8	.02	2994329.	21519329			
20	833000	2307410	.125	288426.3	1673426.	10423426	11567550	1.6912e8	.02	3213347.	21738347			
21	917000	2540090	.125	317511.3	1702511.	10452511	11608202	1.8069e8	.02	3433130.	21958130			
22	1000000	2770000	.125	346250	1731250	10481250	11648549	1.9230e8	.02	3653686.	22178686			

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APPENDIX G: ANALYSIS OF ALTERNATIVE POLICIES

MODADJC Alternative Policies. Average Bonus = $9.85: New Royalty Rate = 15%.

Disk D-5 Production under MRN declines 10% in year 2000.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	YEAR	TOT ACRE	OLD ACRE REN	RATE	OLD RENT	DD ACRE	DD RATE	DD PENS	NEW ACRE	NEW RENT	AV BONUS	BONUSES	INCOME	OO PROD
2	1980	3636882	2688930	1.5	4033395	999278	1.25	1249098	947952	1421928	24.24	22976263	29144716	1700489
3	1981	4628813	3500174	1.5	5250261	1131725	1.25	1414656	1128639	1692959	14.11	15923518	23692375	
4	1982													
5	1983	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	2000000
6	1984	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	2000000
7	1985	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	2000000
8	1986	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	2000000
9	1987	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	2000000
10	1988	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	2000000
11	1989	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1900000
12	1990	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1800000
13	1991	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1700000
14	1992	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1600000
15	1993	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1500000
16	1994	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1400000
17	1995	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1300000
18	1996	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1200000
19	1997	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1100000
20	1998	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	1000000
21	1999	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	900000
22	2000	5500000	4500000	1.5	6750000	1000000	1.25	1250000	1000000	1500000	9.85	9850000	19350000	800000

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	O PRICE	OO VALUE	OOR RATE	OO ROYAL	NO PROD	NO VALUE	NOR RATE	NO ROYAL	TO ROYAL	OG PROD	G PRICE	OG VALUE	OGR RATE	OG ROYAL
2	20.67	35149100	.125	3637689		0			3637689	3624719	1.18	4277168.	.125	639307
3			.125	8161878		0			8161878				.125	1278576
4						0			0					
5	35	70000000	.125	8750000		0	.15	0	8750000	4000000	2.77	11080000	.125	1385000
6	35	70000000	.125	8750000		0	.15	0	8750000	4000000	2.77	11080000	.125	1385000
7	35	70000000	.125	8750000		0	.15	0	8750000	4000000	2.77	11080000	.125	1385000
8	35	70000000	.125	8750000		0	.15	0	8750000	4000000	2.77	11080000	.125	1385000
9	35	70000000	.125	8750000		0	.15	0	8750000	4000000	2.77	11080000	.125	1385000
10	35	70000000	.125	8750000		0	.15	0	8750000	4000000	2.77	11080000	.125	1385000
11	35	66500000	.125	8312500	90000	3150000	.15	472500	8785000	4000000	2.77	11080000	.125	1385000
12	35	63000000	.125	7875000	180000	6300000	.15	945000	8820000	4000000	2.77	11080000	.125	1385000
13	35	59500000	.125	7437500	270000	9450000	.15	1417500	8855000	4000000	2.77	11080000	.125	1385000
14	35	56000000	.125	7000000	360000	12600000	.15	1890000	8890000	4000000	2.77	11080000	.125	1385000
15	35	52500000	.125	6562500	450000	15750000	.15	2362500	8925000	4000000	2.77	11080000	.125	1385000
16	35	49000000	.125	6125000	540000	18900000	.15	2835000	8960000	4000000	2.77	11080000	.125	1385000
17	35	45500000	.125	5687500	630000	22050000	.15	3307500	8995000	4000000	2.77	11080000	.125	1385000
18	35	42000000	.125	5250000	720000	25200000	.15	3780000	9030000	4000000	2.77	11080000	.125	1385000
19	35	38500000	.125	4812500	810000	28350000	.15	4252500	9065000	4000000	2.77	11080000	.125	1385000
20	35	35000000	.125	4375000	900000	31500000	.15	4725000	9100000	4000000	2.77	11080000	.125	1385000
21	35	31500000	.125	3937500	990000	34650000	.15	5197500	9135000	4000000	2.77	11080000	.125	1385000
22	35	28000000	.125	3500000	1080000	37800000	.15	5670000	9170000	4000000	2.77	11080000	.125	1385000

	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
1	NG PROD	NG VALUE	NGR RATE	NG ROYAL	TG ROYAL	T ROYAL	TRUS INC	TRUS BAL	INT RATE	INTEREST	INT+INC	PV: I+I	PV:BONUS	PV:T ROYS
2		0		0	639307	4276996	5734232.							
3		0		0	1278576	9440454	10625073							
4		0		0	0	0								
5		0	.15	0	1385000	10135000	11102500	0	.02	0	18382500	2.6387e8	1.2992e8	1.3685e8
6		0	.15	0	1385000	10135000	11113603	11102500	.02	210947.5	18593448			
7		0	.15	0	1385000	10135000	11124716	22216103	.02	422105.9	18804606			
8		0	.15	0	1385000	10135000	11135841	33340819	.02	633475.6	19015976			
9		0	.15	0	1385000	10135000	11146977	44476659	.02	845056.5	19227557			
10		0	.15	0	1385000	10135000	11158124	55623636	.02	1056849.	19439349			
11	75000	207750	.15	31162.5	1416163.	10201163	11235444	66781760	.02	1268853.	19651353			
12	150000	415500	.15	62325	1447325	10267325	11312842	78017204	.02	1482327.	19864827			
13	225000	623250	.15	93487.5	1478488.	10333488	11390318	89330046	.02	1697271.	20079771			
14	300000	831000	.15	124650	1509650	10399650	11467870	1.0072e8	.02	1913687.	20296187			
15	375000	1038750	.15	155812.5	1540813.	10465813	11545501	1.1219e8	.02	2131576.	20514076			
16	450000	1246500	.15	186975	1571975	10531975	11623209	1.2373e8	.02	2350941.	20733441			
17	525000	1454250	.15	218137.5	1603138.	10598138	11700994	1.3536e8	.02	2571782.	20954282			
18	600000	1662000	.15	249300	1634300	10664300	11778858	1.4706e8	.02	2794101.	21176601			
19	675000	1869750	.15	280462.5	1665463.	10730463	11856799	1.5884e8	.02	3017899.	21400399			
20	750000	2077500	.15	311625	1696625	10796625	11934819	1.7069e8	.02	3243178.	21625678			
21	825000	2285250	.15	342787.5	1727788.	10862788	12012916	1.8263e8	.02	3469940.	21852440			
22	900000	2493000	.15	373950	1758950	10928950	12091091	1.9464e8	.02	3698185.	22080685			

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